

CHEMICAL & METALLURGICAL ENGINEERING

For the Production Man in the Chemical Engineering or Process Industries interested in heavy, fine, and electro-chemicals, cement, lime, ceramics, cellulose, coal products, explosives, fertilizers, glass, leather, paint, varnish, oils, pulp, paper, petroleum, rubber, soap, sugar and similar products.

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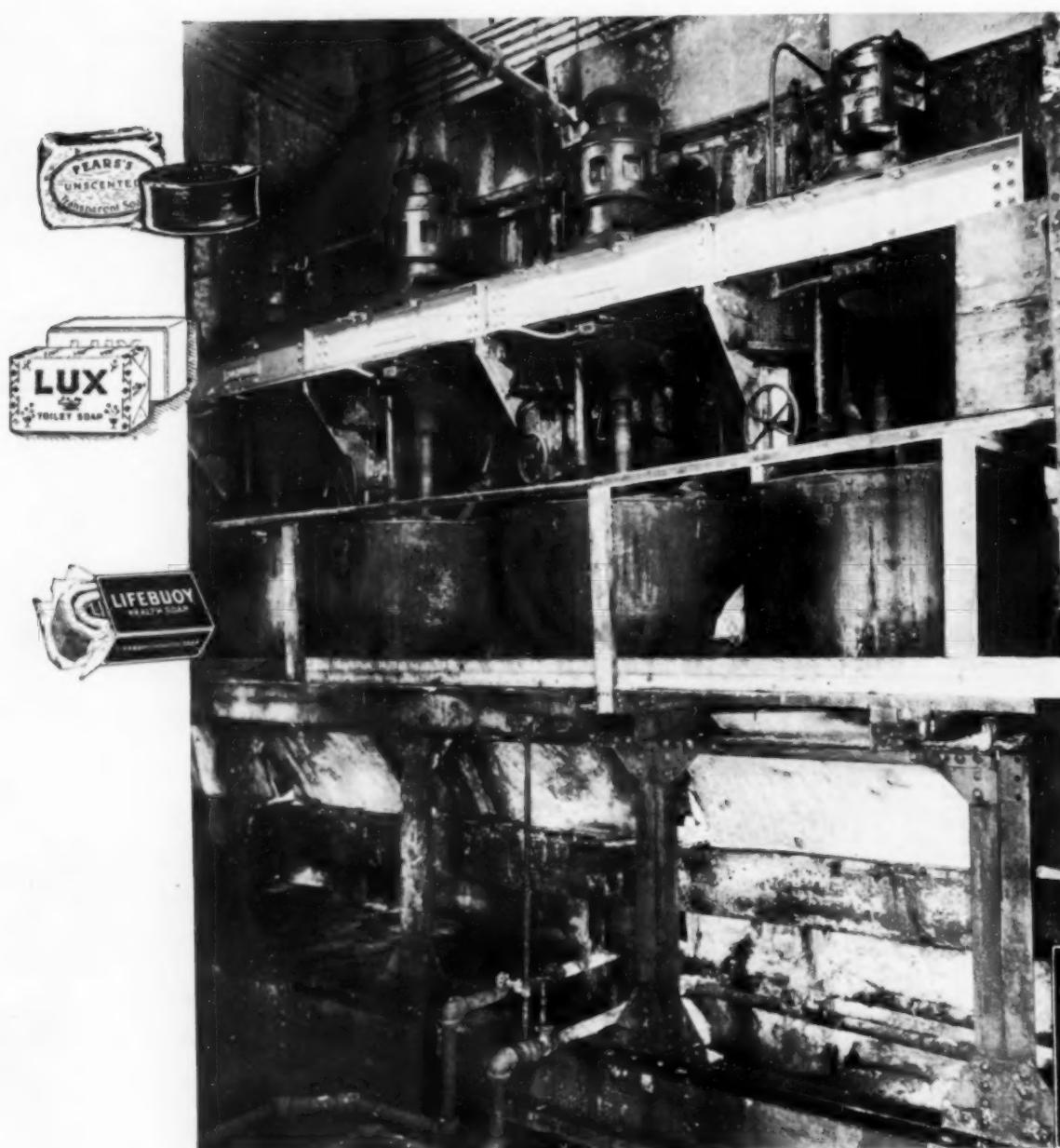
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Help the Other Fellow by Helping Yourself

SPECIAL theme issues of *Chem. & Met.*, such as those on "Corrosion," "Severe Service" and "Process Steam" have served as clearing houses for the exchange of ideas and experiences of hundreds of chemical engineers and production men in the process industries. "MODERNIZATION" is to be the central theme of the September, 1928, issue and if you have had a hand in eliminating obsolete processes and equipment in your plant, you are especially invited to participate in this discussion. A short article, a brief note or merely a letter to the editor telling the results of your experience will be welcome. Your effort will be rewarded in dollars and cents, as well as in increased prestige and the satisfaction of helping the other fellow.

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CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE
Editor

Volume 35

New York, July, 1928

Number 7

Building the Technical Organization for Permanence and Profits

AT A TIME when industry is recruiting its human raw material from the ranks of recent graduates of our engineering schools, it is appropriate to give some thought to the type of technical organizations we are developing in this country. The German criticism that American chemical industry is built on dollars, rather than on men and accumulated technical knowledge, is a warning that management in many industries can well heed. Spectacular achievements have sometimes been made by the brute force of money alone, but more often such a misguided course has resulted in serious and unnecessary loss. The building of a sound research organization on a permanent basis should be a secured investment and not a speculative plunge.

NOT long ago a great chemical and metallurgical corporation that has spent millions in fundamental investigation drastically curtailed its research activities and disrupted a remarkable organization of technical personnel. Today the brilliant leaders of that research department occupy prominent positions as consultants, and their knowledge and experience, which the corporation built up at a tremendous cost, become available to any in the industry for a few hundred dollars a day. The futility of such an attitude toward research should be evident even to a board of directors whose members spend but twenty minutes a month on company affairs, and whose knowledge of the business seldom extends beyond the size of the last dividend.

RESEARCH writes an endowment policy for an industry's future. But like insurance, it can as easily lapse. Or, in a moment of weakness, the holder can sometimes

cash in on the endowment and make a trivial but immediate profit at the sacrifice of the greater eventual gain. It is not necessary to carry the simile further, but even so elementary a comparison is sometimes useful. Men in technical organizations, whether in the position of managing or being managed, can always help in maintaining an enlightened attitude toward research. This duty is more apparent as new men come into the organization and are being developed for positions of responsibility.

THESE men come into a company with a desire to grow in their jobs. They want to learn, and their desire for knowledge and experience should not be stifled either by a militaristic management of fixed opinion and hide-bound precedent, or by a vacillating policy of insecurity that discourages creative work and makes a man fear for the future of his job. The size of the human scrap pile is no measure of an industry's efficiency. What is impersonally called "labor turnover" is more costly in a technical organization than in any other. To avoid it by a process of building slowly but permanently is one of the lessons that American chemical industry can learn from the older and more experienced industries of Europe.

WHAT is needed most is industrial leadership that is grounded in the fundamentals of human relationship. J. G. White once remarked that he was always in need of "engineers who could engineer his engineers." These are not the immediate products of our engineering schools, but are the men whose knowledge of men will make possible the building of great permanent technical organizations in this country.

Chile Declares Its Nitrate Tax Policy

CHILE appears determined to give every possible aid to the maintenance of its nitrate industry. For several years there have been frequent forecasts that such assistance would be forthcoming through a reduction in the export tax, which amounts to approximately \$11 per ton of nitrate. Now, however, the Chilean government has taken a somewhat different course, and promises to offer a bonus to Chilean producers of nitrate to offset lowering of prices of nitrogen products made by synthetic methods.

The official announcement of this policy was made to Chilean producers during the late Spring. The bonus promised was to be equal to any reduction in the price of nitrogen compounds made by the Stickstoff Syndikat when it announced its price schedule for the coming year. The bonus was to be granted to nitrate producers and to their customers on nitrate either unsold, on shipboard, or in the ports of destination on June 30 of this year, or on nitrate subsequently exported up to April 30, 1929. The fact that the official price schedule for the coming nitrate year recently announced by the Stickstoff Syndikat makes practically no change in prices indicates that no immediate bonus will be granted to Chilean nitrate producers and users. However, the bonus will presumably be granted subsequently during the year if later announcement is made of price change effective prior to April 30, 1929.

In any event, it is of importance to know that the Chilean government proposes to place the Chilean industry on as favorable a footing as possible with reference to other nitrogen industries. It is a clear declaration of Chile's intention to use government tax money to offset economies or curtailment in profits accomplished elsewhere in the world. It clearly means that the inorganic nitrogen user can count on receiving lower priced nitrogen whenever advances in the art of synthetic nitrogen fixation permit large economies, and that such lowering of prices will be effective not only on the synthetic product but also on competitive materials.

More Intensive Service to the Food Industries

IN THE EDITORIAL conduct of *Chem. & Met.*, an effort has always been made to portray the application of chemical engineering over the broad field of industry. Although progress has been emphasized where it was being made most rapidly, nevertheless editorial attention has been directed also to those areas of industry in which chemical engineering has only begun to gain recognition. From the vantage point of this broad service the desirability has always been foreseen of occasionally lifting a single industry out of *Chem. & Met.*'s general field, and publishing a separate magazine devoted to that industry's special needs and problems. Service to such an industry could thereby be extended beyond the limitations imposed on a general chemical engineering medium.

It is with this purpose in view that the McGraw-Hill Publishing Company will publish, beginning in October, a new monthly magazine—*Food Industries*—devoted to the manufacture and processing of food. The feeding of over one hundred million people in this country must

inevitably become a tremendous problem in science and economics, calling for the application of chemical engineering principles to the problems of conservation, cost reduction and improvement of quality. The new magazine will be an exponent of these ideas, supporting the progressive elements of the industry and encouraging the adoption of scientific principles and practice throughout the broad field of food production.

Fortunately it will be possible to serve the food industries as a whole because the constituent parts have a common interest in many fundamental operations. Problems in sanitation, material handling and heat technology are common to all. Drying, evaporation, filtration, refrigeration and air conditioning are of broad application, and one branch of the industry can adapt to its peculiar needs the fundamental principles successfully applied elsewhere. Research must be encouraged and extended, and the results applied to production. It is on this comprehensive platform of service that *Food Industries* will make its initial appearance next October.

A Closer Union of Technology and Business

WITHIN the month there has been another extension of McGraw-Hill publishing activities that holds much of interest and promise to chemical engineers. Supplementing its specialized service to the major engineering industries, the McGraw-Hill organization has now acquired a medium through which it can speak to the whole range of American business. The merger with the A. W. Shaw Company of Chicago, announced in the news pages of this issue, represents a significant joining of technical and business publishing for more effective service to both.

Chemical engineers will recognize in this broadening of interest a trend already exemplified to some extent in the activities of the McGraw-Hill Book Company, which publishes books on general business and management as well as engineering and chemical technology. Now, through *The Magazine of Business*, the organization will bring to the whole structure of American business the viewpoint and background of engineering thought as applied in the solution of the fundamental problems of all industry. Such an influence, deriving its strength and authority from the individual engineering and industrial publications, will make for a better appreciation of technology and, conversely, for a widened responsibility on the part of the technologist.

The Order Changes in Pressure Vessel Construction

IT IS, perhaps, premature to raise the cry, "King Rivet is dead, long live the king!", but the signs of the times point unmistakably toward a decreasing favor for the rivet as a means of jointing, and an ever increasing use of welding, be it electric, oxy-acetylene or Thermit. We have now seen bridges and buildings welded and innumerable mechanical parts. The field of electrical equipment has proved a fertile one for the application of welding.

It is, however, in the province of pressure equipment that *Chem. & Met.*'s chief welding interest centers. Welding is regularly used now for much power plant piping

and many gas lines, while two or three all-welded gas holders have come to our attention. Equipment of relatively large diameter, wherein stresses are large and failure may mean the loss of lives and far more in value than the cost of the equipment, is beginning to play an important part. Cracking stills and autoclaves, heat exchangers and towers of various kinds have yielded to the welding torch. Yet, only recently King Rivet has reigned supreme and the pretender, welding, has been viewed with suspicion by the engineering fraternity. Now, however, the King is old, he grows weak, and the pretender assumes the dignity of the heir apparent.

What the use of welding for pressure vessel construction is going to mean in dollars and cents savings and in increased safety is now scarcely whispered. Suffice it to say that there will be worthwhile savings, and that, as for increase in safety, the handwriting is looming on the wall for the engineer who will read. R. S. McBride, elsewhere in this issue of *Chem. & Met.*, expands upon the theme of welding and welding control in pressure equipment fabrication with results that may prove startling to many chemical engineers. Is it generally realized that the assumed factor of safety of five, ordinarily granted to riveted pressure vessels, and based upon the ratio of fiber stress to ultimate strength of the sheet, is a mirage? Is it realized that a test to the elastic limit of riveted equipment is impossible, for virtual failure must take place considerably below this pressure through joint leakage?

Welds may now be produced which are as strong as or stronger than the parent metal. Not only this, but such welds may be produced consistently by the skilled welder. The vessels he constructs may be tested to the actual elastic limit, or to destruction, thus disclosing hidden stress concentrations. A new tool of design is made available. Cheaper, lighter and stronger equipment is possible. An actual factor of safety of three, of five or of ten, if you will, is guaranteeable. No longer is the factor, as it was described by an electrical engineer, the feather bed of ignorance. The erstwhile pretender has made a strong bid for King Rivet's throne.

Exit, the Wood Butcher— Enter, the Chemical Engineer

"I DO NOT KNOW of any more dubious undertaking than commercial reforestation which has for its end the production of lumber. . . . For a safe program for success and reforestation we may, perhaps, look to Sweden. Swedish forests growers count upon a full utilization of their property as the best assurance for profitable reforestation. They do not count upon the sawmill alone. They join to it the paper mill, charcoal burning, and byproducts; and their experience has been that in periods when the lumber business was unprofitable their paper production frequently carried them over a threatened disaster. It is my feeling that the history of Southern reforestation is likely to follow much the same course. Only by complete utilization can reforestation be commercially feasible."

This was the policy of continuous forest growth, complete utilization, and continuing development of byproducts advocated by Colonel A. C. Goodyear, president of the Great Southern Lumber Company, of Buffalo, New York, before the National Committee on Wood Utilization. And in no less vigorous language Colonel Goodyear forecast the day when no sawmill waste would be burned

as fuel, but all would be treated for extraction of turpentine, rosin, and other products, and the best grades utilized for pulp wood.

"We have, so far, seen only the beginning of chemical research in the southern pine lumber and pulp industry," said Colonel Goodyear. "The companies with which I am connected have built a fully equipped laboratory for experimental work. We believe it is one of the most important parts of our operations. We live in hope that the day may come when we will have established those operations on a perpetual basis, but we are equally hopeful that the time will never come when we can rest satisfied with our utilization. In that respect, as conditions change, we may look to a never-ending possible improvement."

These remarks leave little room for further editorial comment. But they do suggest an inspiring opportunity for the chemical engineer to become active in the field of efficient and complete utilization of our vanishing forest resources. If he becomes sufficiently active in this field, the rebuilding of forest reserves will become financially profitable; and the problem of reforestation will then be automatically solved.

A Scientific Millennium Announced in New Orleans

AT LAST the story can be told! Research and discovery have been put on a quantity production basis in New Orleans with results that are soon to startle that historic center of Southern culture. Late last year a limited number of presumably appreciative citizens received a beautifully engraved card carrying this dignified message:

Lucien V. Alexis announces one hundred and more basic discoveries in physics and chemistry. New Orleans, Louisiana, United States, December twelfth, One Thousand Nine Hundred Twenty-Seven

After a few weeks of anxious waiting, the suspense was somewhat relieved by a less cryptic but equally handsome announcement, this time accompanied by a personal visiting card giving the address of the distinguished scientist. The announcement was as follows:

Lucien V. Alexis announces that the hundred and more basic discoveries recently claimed present much knowledge obtained through experimental, demonstrative and analytical proofs; that they explain scientifically facts in physics and in chemistry, some, heretofore, unexplained, and some, wrongly explained; that they lay bare the real laws governing the causes of such phenomena as atomic structure, atomic weight, light, electricity, gravitation, magnetism, Rontgen rays, Hertzian waves, solids, liquids, etc.; and that they presage momentous changes in human thought.

New Orleans, Louisiana,
January 3, 1928.

The general public, the editors of this magazine included, had to wait until July 1 for their copies of this announcement. Ours carries in addition, however, a typewritten *nota bene* promising that first publication of the Alexis discoveries will appear during July, 1928. While anxiously awaiting the momentous disclosure, we feel it our duty to notify *Chem. & Met.* readers of the approach of this scientific millennium. Perhaps there will be an explanation even of "the causes of such phenomena as . . . liquids" of the variety New Orleans now denatures for legitimate consumption by chemical industries.

Welded Construction

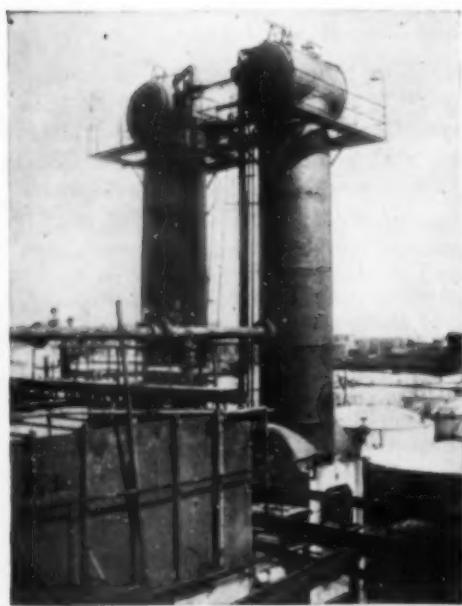
Produces Safer and Cheaper P

Below is an all-welded heat-exchanger fabricated from piping and installed in a petroleum refinery.

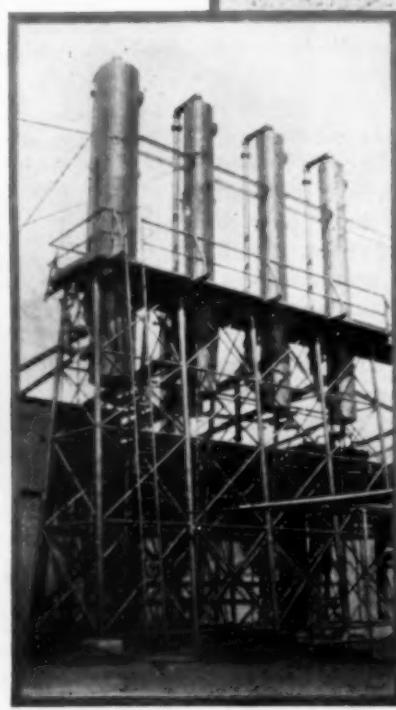
At the right is a group of welded storage tanks designed for 125 pounds operating pressure.



At the right are two welded steel headers, illustrating the large savings in weight that are possible from this construction.

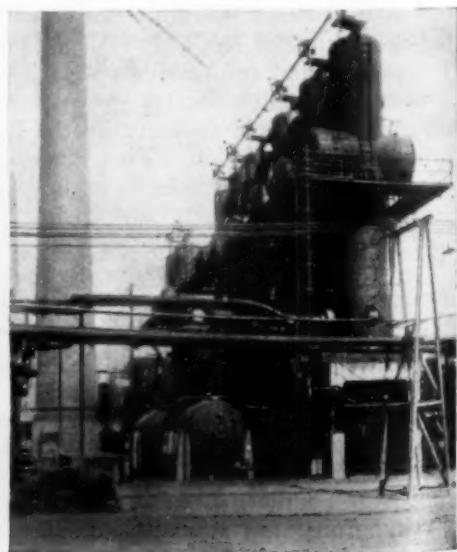


Two all-welded fractionating towers in a petroleum refinery are depicted above. The welded joints are clearly visible through the insulating covering.



Petroleum refinery absorption towers and supporting framework, all of welded construction, appear at the right center.

A group of modern, welded fractionating towers, again in a petroleum refinery, are shown below.



Pressure Equipment

By R. S. McBride

Assistant Editor, Chem. & Met.

WELDING PROCEDURE control requires six equally important steps in the building of high-pressure chemical engineering equipment. Through the careful following of these steps the chemical equipment builder secures fully double the previous factors of safety, reduces the weight and lowers cost of apparatus, gains superior equipment performance, and has an actual test of pressure equipment up to the elastic limit of the metal from which it is made. Neglect of any one of the six requirements may defeat the whole undertaking. Especially with pressure equipment, a failure in service of either welded or riveted equipment may mean loss of life or destruction of property exceeding many times the value of the unit which fails.

These six important requirements are:

- 1—Correct design of both vessel and joint
- 2—Selection of good weldable materials
- 3—Employment of able, trained welders
- 4—Proper preparation of the material used
- 5—Observance of good welding technique
- 6—Adequate test of the completed vessel

Ideal conditions for high-pressure equipment building would require a test of the completed apparatus up to at least three times the maximum anticipated working pressure. This result is not possible with riveted construction, but it is not only possible, but actually practical, with welded equipment. Moreover, the practice of hydraulic testing far beyond the maximum anticipated working pressure has developed information regarding the design of both the joints and the general structure of equipment which is now affording many new opportunities in chemical engineering apparatus. A whole series of fundamental changes have been brought about, affording greater safety and economy in both the building and operation of pressure apparatus.

One would think that many years of tank design had led mechanical engineers to ideal forms long ago. However, the fact is that riveted tanks which were built with a supposed factor of safety of five, which is quite ample, actually afforded not over half this, and in some cases less than one-third this margin of safety. The whole series of engineering formulas underlying pressure equipment design has been based upon certain erroneous assumptions which could not be detected until it was feasible to carry test pressures to the actual elastic limit of the metal used.

Riveted equipment, as formerly built, was commonly designed with an assumed maximum design fiber stress of 10,000 lb., using metal of 50,000 lb. tensile strength, and about 27,000 lb. elastic limit. This design was assumed to give a factor of safety of five, namely the ratio between design fiber stress and tensile strength. Obviously this factor of safety neglected the very apparent fact that failure would begin at 2.7 times the stress for which the design was figured, that is, at the elastic

limit. Furthermore, the assumed factor of safety never could be tested because the riveted joints began to leak seriously at about 1.5 times the design stresses. Hydraulic tests above that figure resulted in joint leakage which was practically equivalent to equipment failure.

With welded construction, a very different situation has developed. Let us assume that a tank is designed with the same fiber stress, tensile strength and elastic limit that has been customary in riveted construction. On completion of the tank it is very easy to subject it to hydraulic test, either with or without strain-gage measurements, up to the elastic limit of the metal. This has now been done in tank construction with the result that many unsuspected concentrations of stresses have been disclosed.

Hydraulic testing will obviously disclose the weakest spot in the structure. It will permit changes in shape or changes in the amount of metal at such a weak point without general modification of the rest of the structure. Moreover, these tests have frequently disclosed that unnecessarily heavy plate is being used for tank walls without gaining the anticipated security because of the shape of the heads of the tank and the manner in which manholes or connecting fittings are attached. Recognizing the great advantage of a lighter shell if adequate safety could be secured, the petroleum industry has urged, and has secured, tentative approval on the adoption of tank cars made of $\frac{3}{4}$ -in. plate, replacing designs which formerly required plate of $1\frac{1}{2}$ -in. thickness. Numerous advances in tank, kiln, and other equipment construction have been made in a similar fashion. In many cases the metal savings have amounted to as much as 15 or 20 per cent of the original material weight, with actual increase in strength of the finished equipment.

Proper joint design is, of course, a vital consideration in pressure equipment. It is not enough to use the proper curvature of head and the proper reinforcing rings at the base of the manholes. It is just as essential that the bevel on the plate and the thickness of the plate or insets near the joint should be correct. For example, it is important in joining a manhole reinforcing ring to the body of a tank to have the edge of the reinforcing ring properly tapered down to the approximate thickness of the plate at the point where it is to be welded to the shell. If this is not done there will be so great a difference in the heat conductivity in the two directions away from the joint that there will result abnormal stresses in the metal and local weakness in the structure. A failure at some point of stress concentration may result. This problem must be considered in every feature of equipment design. Some of the ways in which it is permissible to attach pipe nipples, sumps, and manhole rings are clearly shown in the accompanying diagrams.

IT IS OFTEN assumed that the skilled welder can weld any metal under almost any conditions needed by industry. This rather amazing belief has led to much slovenly design and much unnecessary taxing of the welder's skill and ingenuity. To that extent the wide applicability of welding has been handicapped. But its almost universal possibilities afford great comfort to the designer, who very rightly asks that he be permitted to specify the metal which will be most satisfactory from the standpoint of chemical behavior, corrosion resistance and general dependability under plant conditions.

When the general type of steel desired has been selected, it is still necessary, in purchasing metal or in

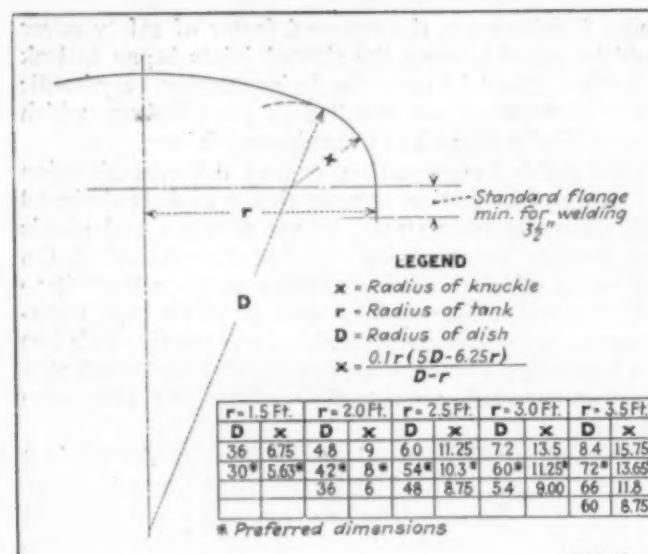


FIG. 7

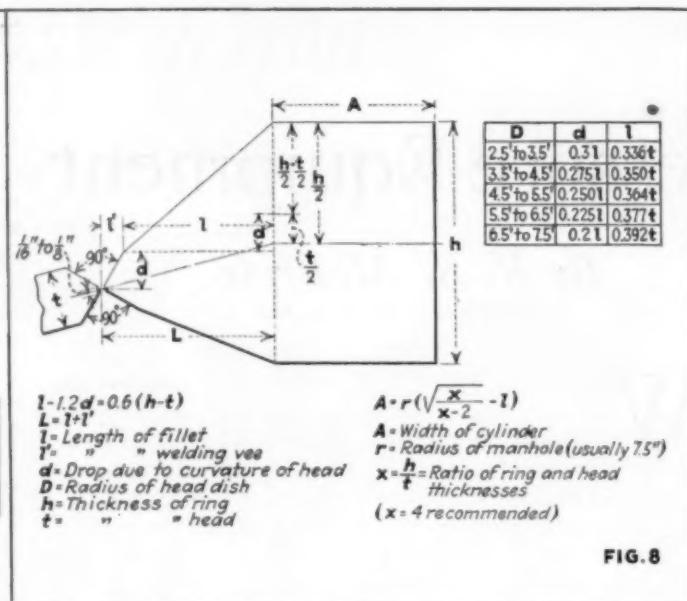


FIG. 8

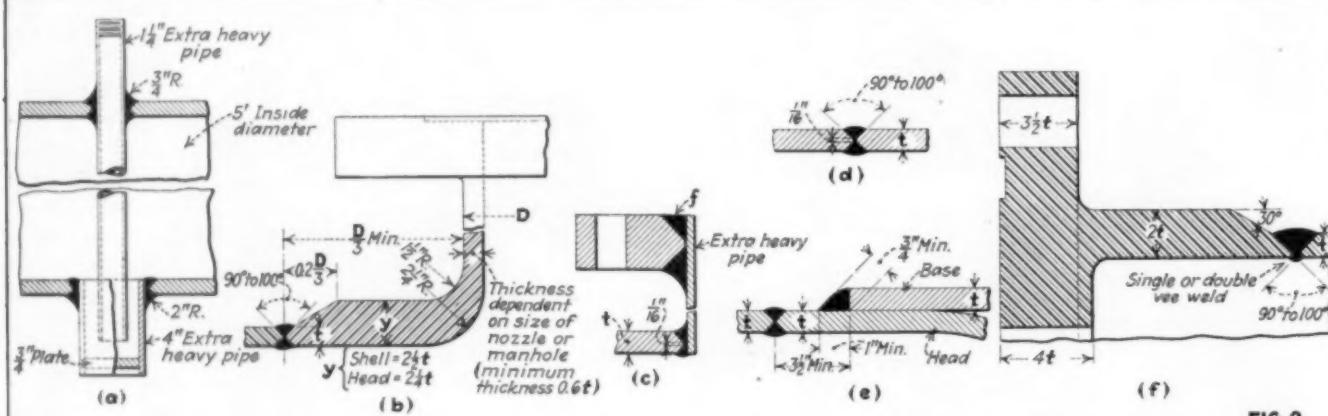


FIG. 9

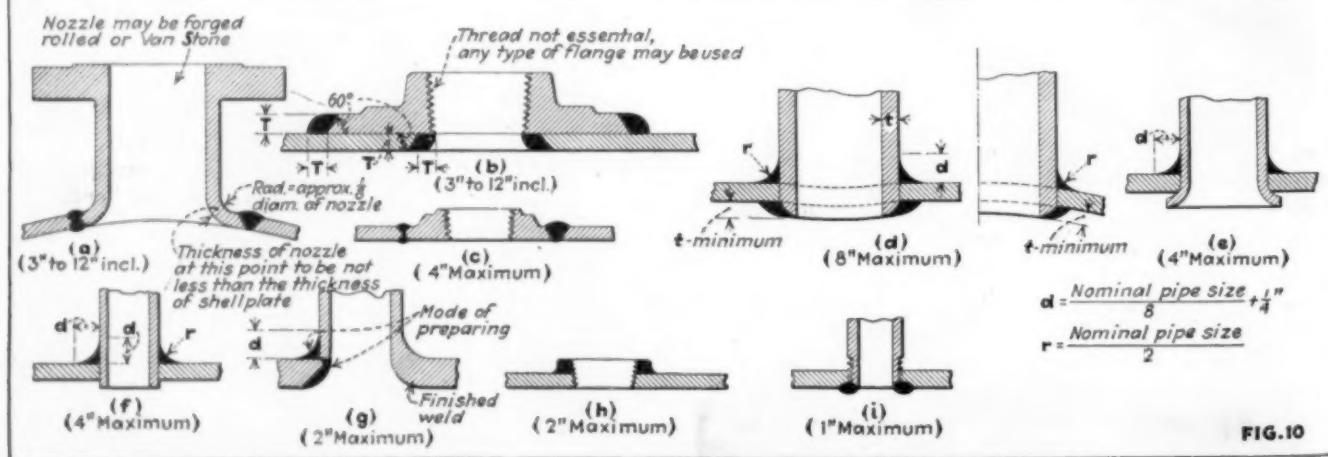


FIG. 10

FIG. 7—Elements of Design of Dished Heads
The starred dimensions are the closest approach to the ideal ellipsoidal form which is the ultimate shape attained if pressure above the elastic limit be applied. This type of head appears in Figs. 11, 12, 13 and 15.

FIG. 8—Design of Manhole Reinforcing Ring of Type Shown in Fig. 11

The ring is to be made of forged steel or cast iron or steel and is intended for use in vessel heads only.

specifying it for equipment building, to make known the fact that the metal is to be used for welded apparatus. When this is known, the metallurgist may choose, within the specifications, a plate which has good welding characteristics. It is likewise important that the plate be supplied with properly beveled edges for most economical

FIG. 9—Group of Miscellaneous Welded Elements
(a) Design for a sump; (b) Forged nozzle for head or shell; (c) Nozzle for head or shell, extra heavy pipe and flange; (d) Double vee weld for any shell seam; (e) At the left is the head seam. Above at the right is attached a cylindrical base for use with dished headed tanks; (f) Forged flange for removable head.

FIG. 10—Miscellaneous Nozzle Welds Recommended by the American Society of Mechanical Engineers in its Unfired Pressure Vessel Code

fabrication. If a square-edged plate is supplied, the welder must use his cutting torch to bevel the plate before assembling the joint. This procedure is costly and wholly unnecessary because the metal industry has already learned what to supply in chemical composition and how to supply it in chemical composition and how to supply it when these require-

ments have been fully specified by the purchaser.

Naturally the designer wishes the joints of his equipment to be just as resistant to corrosion as the body of the apparatus. He therefore seeks to have the finished joint consist of metal as nearly as possible identical chemically and physically with that of the plate itself. This, too, is entirely possible. But, if the finished weld is to be chemically the same as the plate, it is essential that the original welding rod be of different composition. There is an important change in the composition of the rod material during welding. The chemical changes which take place are fairly well known, and it is entirely possible to adjust the rod composition so that the finished weld will be identical with the plate within very narrow limits.

HAVING made proper selection of designs and materials for the construction the chemical engineer has progressed about as far as he should go without turning the problem over to the experienced welding manager. It is a mistake to assume that, because any mechanic can become a welder, therefore any mechanical staff can buy welding equipment and do its own work. To a certain extent this assumption is justified by experience where welding equipment is used for repair and maintenance work. In important welding construction, however, it is much better that the services of carefully trained and competently supervised welders be secured, especially if the construction be of high-pressure equipment. There are relatively few chemical plants which have sufficient welding work to warrant maintaining staffs of specially trained men. Unless the men are specially trained and given every opportunity to keep in touch with the latest developments in this fast-changing art, they are certain to produce less efficient and less safe results than are readily available from those specializing in the business. Such specializing firms will furnish the trained workers, will see to the proper preparation of material, and will insist on their workers following good welding technique.

Finally, the proof of the work will rest in its testing. Specifications for high-pressure equipment should, therefore, include rigid requirements as to test behavior. It is reasonable to demand that equipment which is designed with a so-called factor of safety of five should meet a hydraulic test of two and one-half or three times the maximum intended working pressure. There is probably no reason why a hydraulic test should not be applied to every important piece of pressure apparatus.

The making of such tests has become more or less of

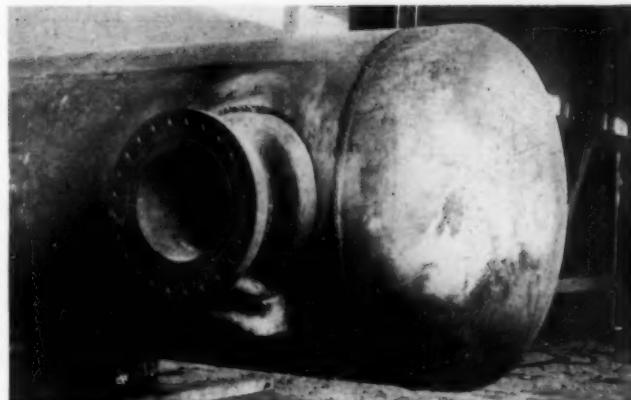


Fig. 12—Welded Nozzle of Type in Fig. 9-b, in Vessel Shell

an art in itself. Naturally there is special apparatus needed, and for economy of time there are short cuts in testing technique which have been developed. Some of the important testing laboratories of the country have, therefore, equipped themselves with proper apparatus and skilled inspectors who will test a purchaser's equipment before it leaves the fabricating plant.

Furthermore, such high pressure equipment can and should be subjected to re-test at appropriate intervals during its life. The relatively small cost of re-inspection is more than justified, especially if the equipment is used for operation with flammable or corrosive fluids, or at exceedingly high pressures or temperatures.

Among tests of welded equipment, one which is most important is that of hammering welds while the vessel is under pressure. In some specifications it is prescribed that each welded seam, while subject to the maximum test pressure, shall be hammered at intervals of 2 in. along each weld with a 12-lb. sledge, swung through an arc of at least 90 deg. There are, of course, many variations of these specifications. In some cases, it is feasible to subject the equipment to test while at a moderately elevated temperature, thus adding the assurance of temperature resistance to that of shock and pressure.

THE story of the construction of a group of six pressure storage tanks, 6 ft. by 26 ft., designed for 300 lb. operating pressure, illustrates excellently the series of technical problems to be considered in actual equipment building. For the indicated diameter and working pressure a shell thickness of $1\frac{1}{2}$ in. was required, based on a design fiber stress of 9,000 lb. per sq.in. The heads were shaped with a total depth of dish equal to one-quarter of the tank diameter, using two sections of spheres for knuckle and crown respectively, in order to give as nearly as possible a semi-ellipsoid with the major axis twice the minor axis. Fig. 7 makes this construction clear. Manholes were required at each end of the tank, and great care was taken in designing the manhole reinforcing ring to maintain only normal stresses in the head plate about the manhole. Similar precautions were taken with pipe outlets and sump connections.

Double-vee, butt-welded joints were used for all seams with vee angles of 90 to 100 deg. and $\frac{1}{8}$ -in. reinforcement on each side of the weld. Because of the greater facility in welding longitudinal seams it was decided to make the tank shell of three plates the full length of the tank and thus eliminate girth seams between the heads. The material used was fire-box steel of 50,000 lb. minimum tensile strength and 0.2 per cent maximum carbon content.

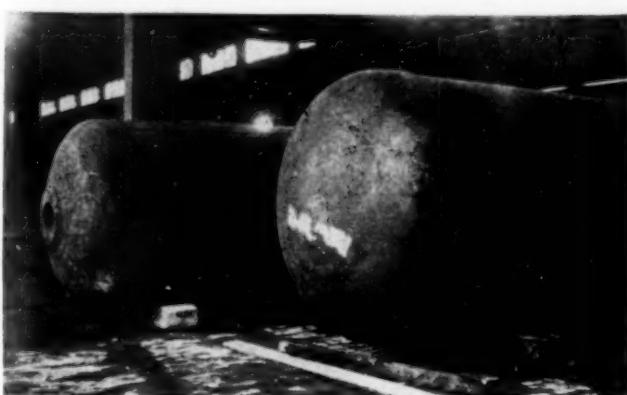


Fig. 11—Welded Heads With and Without Manhole Ring
The manhole ring is of the type shown in Fig. 8. It is used with an inside manhole cover.



FIG. 13—Sections are Joined With Clamps Before Welding
The nozzle is of the type in Fig. 9-b.

The welders were required to pass a qualification test by preparing specimens from welded plate of $1\frac{1}{4}$ in. thickness. These sample plates were cut up into test specimens and only the welders whose work showed 50,000 lb. per sq.in. tensile strength were employed.

The longitudinal plates were tack-welded at the end from which welding progressed. The other end of the open seam was controlled by spreading the plates with wedges so that proper allowance for contraction during welding could be maintained along the entire length of the seam, the spacing at the open end being adjusted as the weld progressed. Heavy plate clamps were employed to hold the plates rigidly in position. The outside weld was completed first, after which the inner vee was chipped out to remove the oxide and excess metal which had penetrated. The joint line was preheated from the outside with a coke fire, over an area 24 in. x 6 in., during the progress of the welding of the inner side of the seam. This preheating for the second portion of the joint provided the requisite annealing of the seam.

Welding of the reinforcing ring into the head required special precautions, both in spacing the parts and in preheating the joint. The ring was first fixed in place by four tack-welds, spaced 90 deg. apart. The head and ring were then preheated by a charcoal fire built under the head. Welding was done by two welders working simultaneously 180 deg. apart. After one side of the weld was completed the head was allowed to cool slowly, the other side of the joint chipped clean, the head re-heated, and the second vee welded. The second heating, combined with the heat of the welding on the second side of the joint, served to eliminate some stresses, but to insure a perfect job the head was completely annealed at the finish of the second part of the weld.

The completed head, with manhole ring attached, was

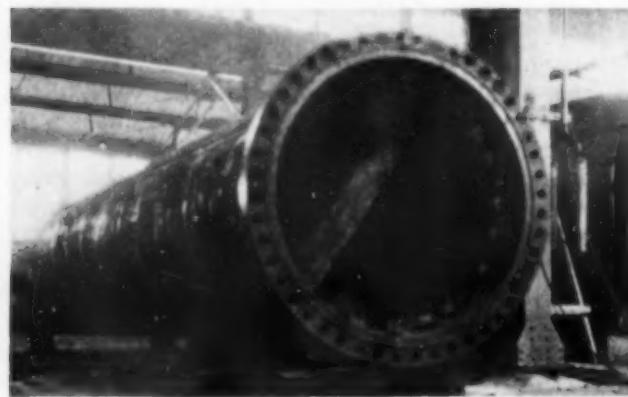


FIG. 14—Flanged Ring of Type in Fig. 9-f Clamped in Place Prior to Welding

aligned with the tank body and clamped in place. After four tack-welds were made, the welding of the circular head seam was accomplished in a manner similar to the welding of the longitudinal tank seams. Any stresses resulting from contraction during the welding of the first side of this joint were fully dissipated through the reheating during the welding operation on the second side.

The testing of the tank on completion was made in several stages. The first test was a hydrostatic test at 600 lb. water pressure with the hammering of all welded seams with a 12-lb. sledge. When this first test was complete, the pressure was increased to 900 lb., corresponding to approximately 27,000 lb. per sq.in. fiber stress in the metal, or 60 per cent greater stress than is called for by A.S.M.E. pressure-vessel codes. Strain-gage measurements were taken at various points on the tank to make sure that the metal had nowhere passed the yield



FIG. 15—Dished Head With Manhole Ring Welded in Place Ready to Attach to Shell

point. The final test was with air pressure at 450 lb. per sq.in. in order to detect minute leakage, if any. A test with soapy water along the welded seams showed no leaks in any of the six tanks in the lot.

There are some most interesting possibilities suggested by these developments of welding as a tool in equipment construction. Let us suppose that the equipment manufacturer is regularly marketing several hundred pieces of unit equipment of a standardized type. It is not at all unlikely that by proper test of a sample, run to destruction, he will discover one or two weak spots in his apparatus, either because of the shape or method of assembly. Correcting these points, a new test will disclose the next limiting factor in strength. After two or three such trials with intervening improvements in design, the manufacturer can logically cut back in his designs, reducing the weight of metal, making reinforcing parts thinner, or even omitting them altogether.

A cycle of tests, failures and redesigns leads to a more or less ideal result. It affords lightest weight equipment which can be sold most cheaply. It is safe. It permits over-all operating economies that are the real test of chemical engineering efficiency. Under these circumstances, it becomes evident that welding as a means for equipment fabrication has afforded far more to the engineer than merely a new means of jointing. It is offering an altogether new prospect in design and utilization of equipment, giving great promise for the future, both to equipment builders and to plant operators.

The writer acknowledges that publications of the Linde Air Products Company and, particularly, certain of the writings of H. E. Rockefeller of that company, have been freely drawn upon in the preparation of the above.

Cornstalks as Chemical Raw Material

By S. D. Kirkpatrick

Associate Editor, Chem. & Met.

IN THE 163 years since Jacob Schaeffer first proposed the use of cornstalks as a raw material for paper manufacture, there have been many attempts to put this great agricultural waste to some profitable chemical use. That none of these has yet been successful on a large commercial scale has not discouraged several pioneer groups of investigators, who believe the solution of the problem lies in chemical research and modern engineering development. Most of this interesting work centers in the states of Iowa and Illinois, where the plight of the corn farmer during recent years has given an added impetus to all scientific attempts to solve the farm problem.

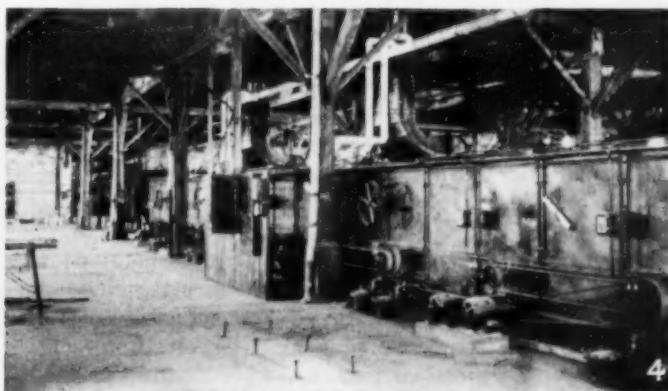
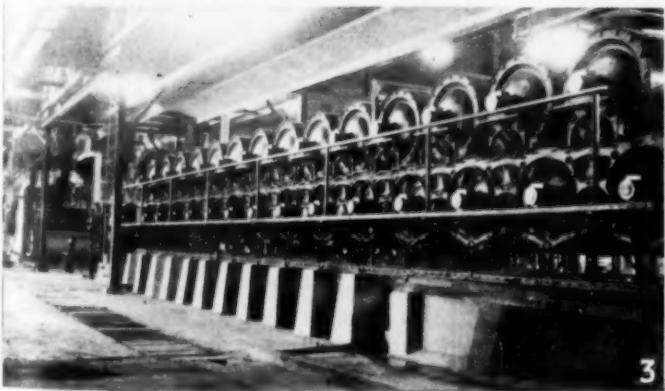
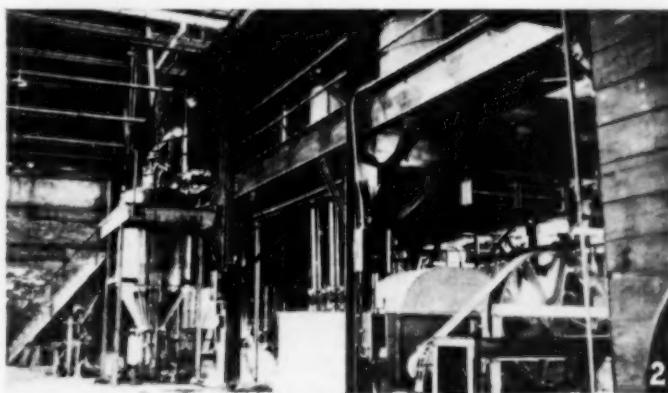
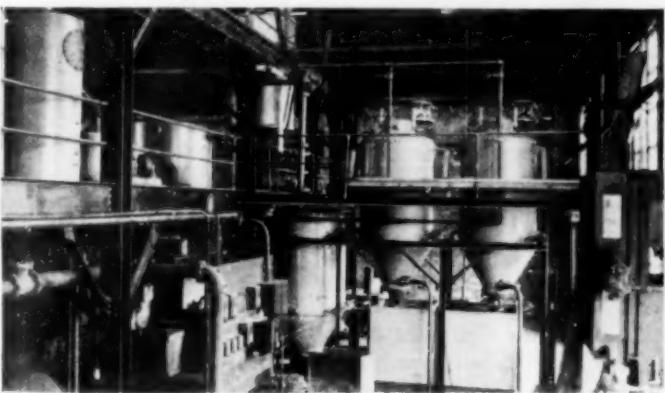
The tremendous extent of this great cellulose reserve is not always appreciated. In 1925, the total acreage of corn in the United States was 101,631,000, and with a

conservative estimate of 1.5 tons of cornstalks per acre, this gives an annual production of 152,446,000 tons. A plant using 50,000 tons of cornstalks per year could be located practically anywhere in the corn belt and obtain its entire supply of raw material within a radius of ten miles. The method of collecting this raw material and hauling it to the factory, however, is one of the most serious problems that the new industry faces. Fortunately, this phase of the subject has not been neglected, for extensive practical study has been made in the field. In Illinois, under the direction of Harvey J. Sconce, the Cornstalk Products Company, collected more than 10,000 tons of

stalks last season, which were baled and stacked at the plant at Tilton, Illinois. (See Fig. 1.) Field investigations and extended studies have also been made by



Ten Thousand Tons of Cornstalks Have Been Collected and Baled for Raw Material for This Illinois Plant



Equipment Installed in the Pilot Plant of the

1. Byproduct recovery and storage facilities. In addition to a high-grade pulp, the company proposes to produce a fermentable carbohydrate material and a so-called pentosan fraction for use in plastics.

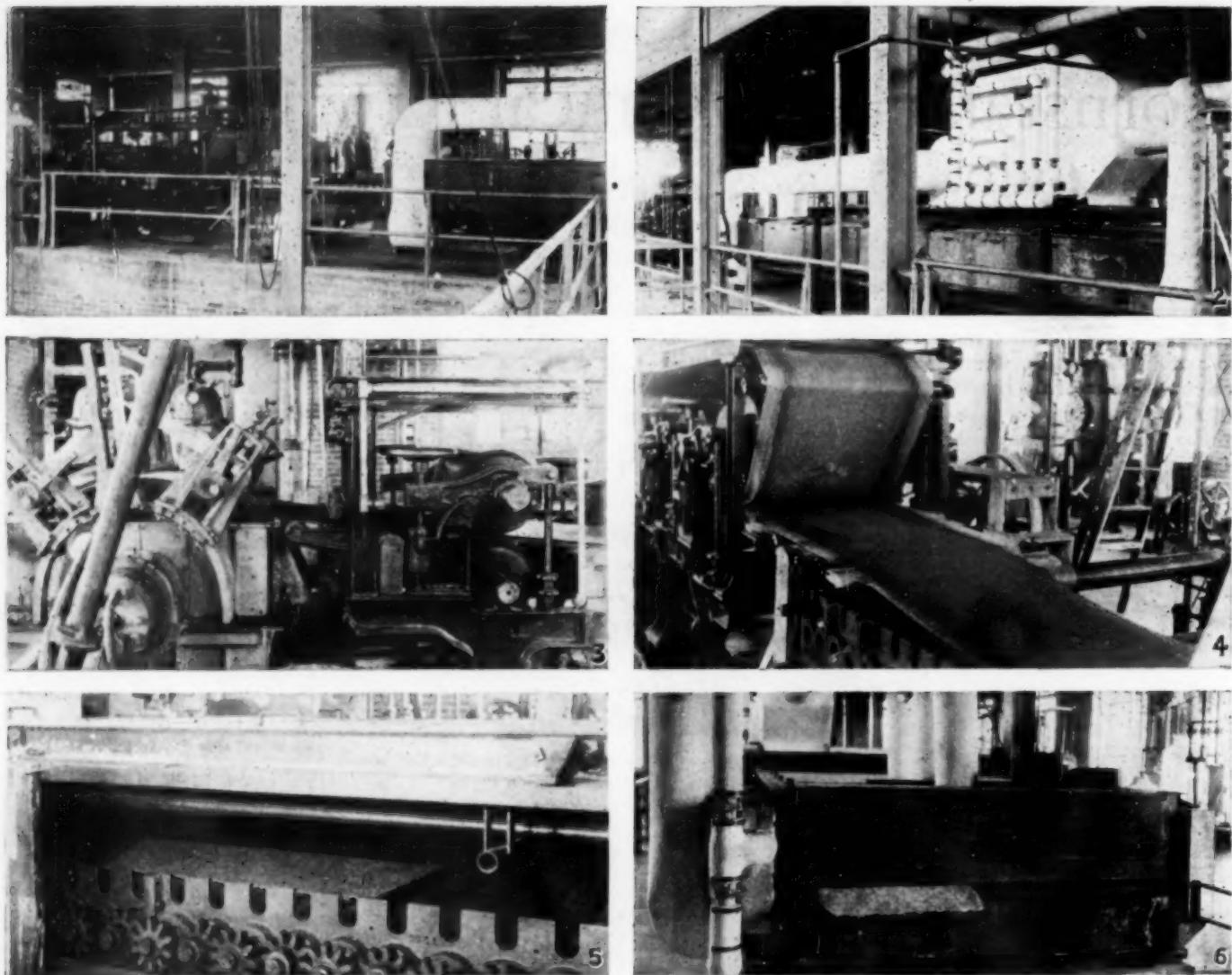
2. View from opposite side of mezzanine showing one of the

Cornstalk Products Company at Tilton, Illinois

twin vertical digesters in which the cornstalks are digested with caustic soda.

3. Side view of the press rolls and wet machine on which the pulp is formed.

4. Sargent drier in which the pulp receives its final drying.



Experimental Plant for Producing Wall Board or Insulating Lumber from Cornstalks in the Chemical Engineering Department of Iowa State College

1. General view of Downingtown press rolls and front of board drier.
2. Side view of Coe drier.
3. Oliver pick-up for forming the board and first part of press rolls.

4. Board leaving the press rolls and passing into the drier.
5. Side view of board drier with one of the insulating panels removed.
6. Discharge end of drier with piece of dried board ready for trimming to size.

Davidson and Collins of the agricultural engineering department of Iowa State College.

ONE OF the most likely products made from cornstalks is wall board or insulating lumber. It is principally in this direction that the work is being done in the chemical engineering department of Iowa State College, under the direction of Professor O. R. Sweeney. This is, however, but a part of a comprehensive research on the utilization of such agricultural wastes as corncobs, straw, etc., which has been carried on over a period of seven or eight years. Bulletin 73 of the Engineering Experiment Station on "The Commercial Utilization of Corncobs" describes the first of this work, and the remainder is to be the subject of another bulletin which will shortly be available from the Chemical Engineering Department, Iowa State College, Ames, Ia.

A year ago, Congress made an appropriation to the United States Bureau of Standards for a study of farm waste utilization, and a part of this money, when matched by funds from the State of Iowa, was used to build the experimental wall-board plant shown in the accompanying photographs (published here through the courtesy of

Warren E. Emley, who has directed the co-operative work for the Bureau of Standards.) The college provided room for the plant in the new Chemical Engineering Building (See *Chem. & Met.*, June, 1928, pages 338 to 341), and the equipment was laid out under Professor Sweeney's personal supervision. Much of the work on the project has been done by Lionel K. Arnold, chemical engineer. The equipment was furnished and installed through the co-operative work of the Bureau of Standards, Iowa State College, and the equipment manufacturers.

The manufacturing process is comparatively simple, but before the project can be accurately evaluated, it has been necessary to determine the performance of each piece of equipment, in order to produce board of maximum strength and insulating value combined with minimum weight. Most important of all, the costs have had to be determined and the material sold in actual competition with insulating material now on the market.

In making wall board, the cornstalks are first shredded in a Badger farm shredder and then beaten in a regular paper beater until the fibers are of proper size. A small quantity of paper sizing is then added and the pulp is

formed into sheets on the Oliver pick-up rolls. The sheet then passes through the pressing rolls and is cut into strips before being passed through the Coe drier to emerge as insulating lumber. The plant at Ames produces a board three-eighths of an inch thick and 2 feet wide, at the rate of 8 feet per minute. This requires about 3 tons of stalks per day for continuous operation. The yield is approximately 90 per cent of the weight of the dry stalks used in the process.

Parchment Paper from Illinois Cornstalks

BY FAR the most impressive commercial attempt to utilize cornstalks as chemical raw material is in the plant of the Cornstalk Products Company, Inc., at Tilton, in Vermilion County, Illinois. Last September the company, which is a subsidiary of the Euro-American Cellulose Products Corporation, purchased an abandoned automobile factory, some car shops, and 52 acres of land lying at the edge of Danville, Illinois. It next proceeded to build and equip a large chemical laboratory. The plant was reconstructed to use a process of Dr. Bela Dorner, a Hungarian chemist, who had worked out a method of producing from cornstalks a high-grade pulp suitable for use as a raw material for the paper and the chemical cellulose industries.

Originally a 1-ton a day pilot plant was installed for the production from cornstalks of alpha cellulose for the rayon industry, and the chemical and mechanical problems involved in the digestion and recovery of byproducts were studied here before the expansion to a 25-ton per day unit. Parallel work was also started on the production of "chemical cotton" from cotton-seed hulls, and with the successful working out of this process, it was decided to change the cornstalk process entirely to the production of a hydrolyzed pulp. Slight modification of the original process gave a pulp well suited for the paper industry, particularly for parchment paper manufacture, and for which there appears to be a large demand at a price of approximately 6 cents per pound.

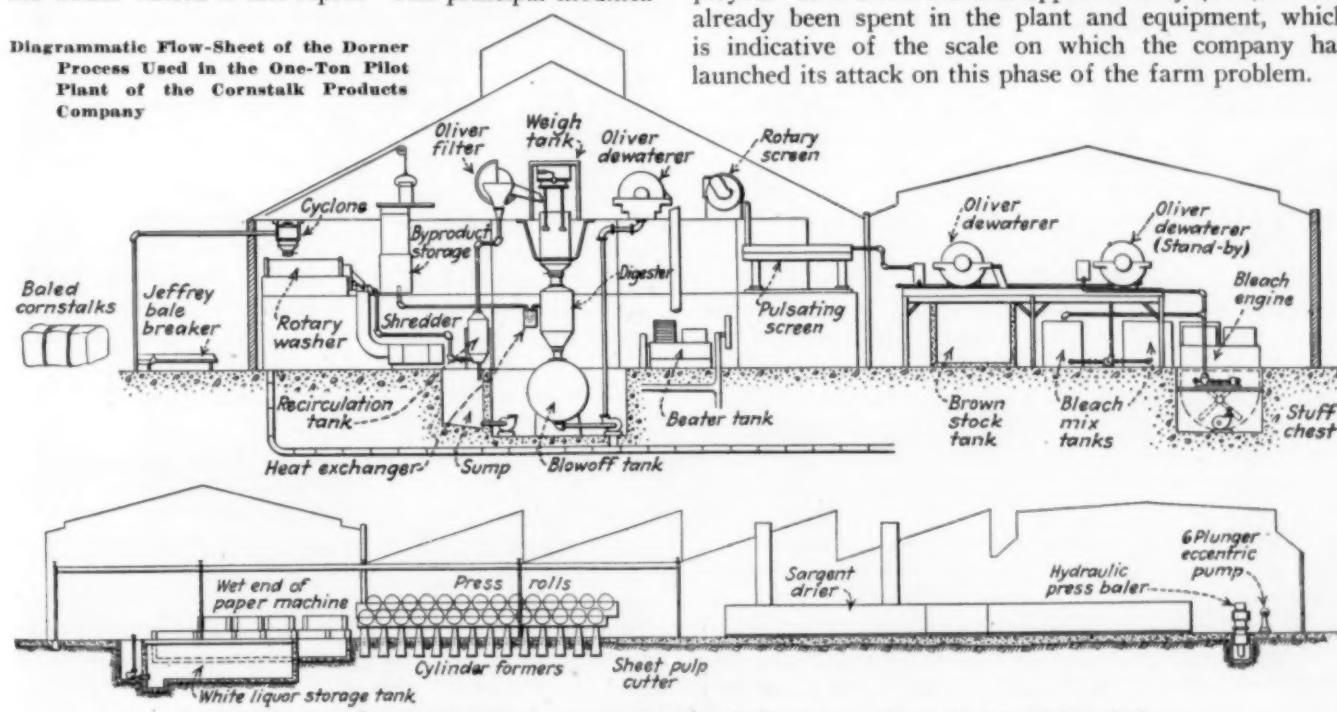
The diagrammatic flow sheets and the photographs on page 401 are of the original pilot plant at the time the writer visited it last April. The principal modifica-

tion in the process since that time has been the substitution of a Claflin refining engine for the washer and beater shown in the drawing. It will be observed that the equipment is practically all of standard chemical and paper-mill design. After the baled stalks are broken in a Jeffrey bale breaker, some dust is removed in a cyclone separator and the stalks are then washed in a rotary washer. This process not only removes the dust, but yields considerable water-soluble material that will be recovered. A Jeffrey hammermill pulverizer further reduces the fiber, which is then ready for the hot-water washing. This water is recirculated in order to build up a marketable content of the fermentable carbohydrates which will be mixed with the cold-water soluble material and marketed as a byproduct. The fiber then passes into twin vertical digesters. Ten per cent, or slightly less, of caustic soda is added and the digestion is carried on at 20 lb. for about two hours. The liquor from the digester, on neutralization, yields a mixture of pentosans and similar compounds that appear to be suited for use in the manufacture of lacquer and plastic raw materials. Thus, in addition to the pulp, there are two possible byproducts of distinct interest to chemical industry.

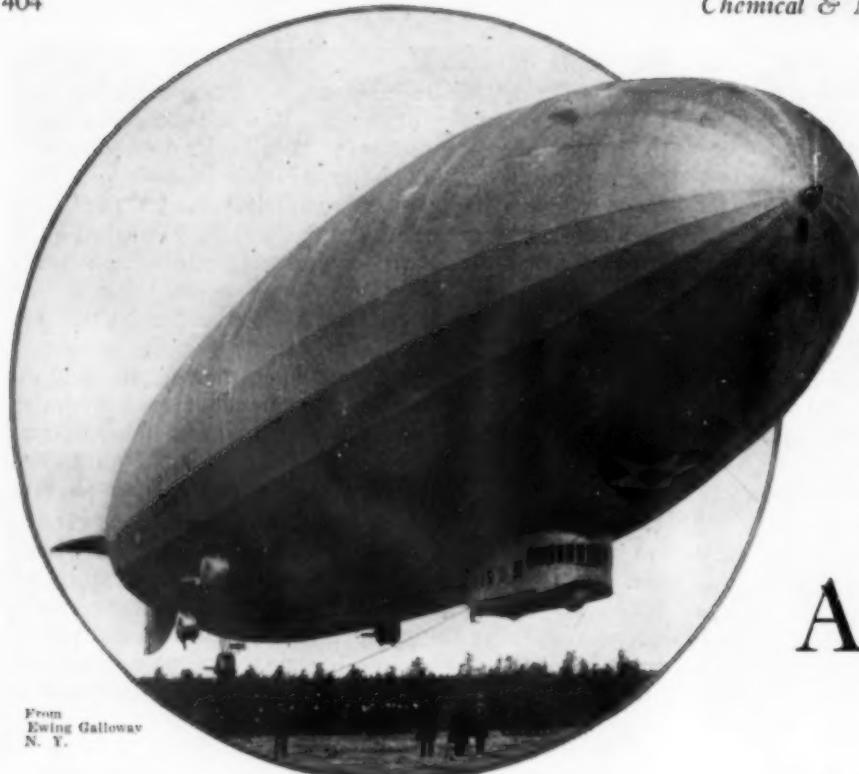
The fiber from the digester now passes directly to the Claflin refiner, is screened to remove oversized fiber, and again dewatered before bleaching with chlorine or bleaching powder. From the stuff chest the bleached fiber passes to the wet machine and is formed into sheets of pulp. These may be shredded or dried directly in the Sargent drier, and after being put through a hydraulic baler, are ready for shipment.

The plant at Tilton is under the management of Frank K. Gardner, and E. F. Hulbert is the chief engineer. Harvey J. Sconce, a member of the board of directors of Armour & Company, and widely known as a successful Illinois farmer, is in charge of raw material procurement. The company maintains a laboratory in New York City, under Dr. John E. Jackson, while at Tilton eight other chemists under Dr. E. R. Darling, formerly of James Millikin University, are now employed. It is estimated that approximately \$350,000 has already been spent in the plant and equipment, which is indicative of the scale on which the company has launched its attack on this phase of the farm problem.

Diagrammatic Flow-Sheet of the Dorner Process Used in the One-Ton Pilot Plant of the Cornstalk Products Company



Above: Cross Section Through the Chemical Pulp Plant. Below: Paper Machine, Press Rolls, Drier and Baler for Handling the Hydrolyzed Pulp



From
Ewing Galloway
N. Y.

LOS ANGELES leaving its hangar
at Lakewood, N. J.

Finishing Modern AIRCRAFT

By R. C. Martin

*Superintendent Lacquer Plant, Glidden Co. of Calif.,
San Francisco*

SPECTACULAR progress has been made in the development of present-day aircraft. As an entirely new industry, it shows the possibility of becoming second only to motor-car manufacture within the next five years. And just as the painting of the automobile was at one time considered a problem, and is to a certain extent today, so can the finishing of modern aircraft be considered a promising field for chemical engineering development. With the advent of all-metal aircraft, the problem is somewhat similar to that presented on the motor car, but more severe, for in addition to the effect of the heat generated by the motor, there is accelerated contraction and expansion of the metal due to weather conditions and rapidly changing temperatures at various altitudes.

Consensus of opinion throughout the aircraft industry is that the "plane of tomorrow" will be one of all-metal construction. Remarkable strides have been made toward that end. All-metal planes in daily use in this country and abroad have proved the practicability of this type of construction. The durability of such a plane should far surpass that of a plane on which fabric is used since wood and cloth will deteriorate, whereas metal when properly protected will last indefinitely. Both types, however, must be considered in any discussion of finishing methods and materials.

Two distinct types of materials used on the wings and fuselage of airplanes are known in the industry as "acetate dope" and "nitrate dope." Whenever the word "dope" is used, it generally refers to a combination of a cellulose derivative, blended with the common esters (e.g., ethyl and butyl acetates) and solvents, such as acetone and benzol.

The preliminary finishing schedule usually includes two coats of dope, which are usually applied over the top cloth by means of a hand brush. These coats are applied at intervals regulated by the necessary drying period.

In the past a complete schedule included five or six coats, all applied by hand brush, but this schedule is now supplanted by a much shorter one, introducing the use of the spray gun, which is more desirable because of the evenness of the application of the dope deposited upon the fabric surface. It is essential, however, that the first two coats are applied by hand with the brush, as this lays the nap of the cloth. With a spray gun this nap would be raised by the air current, and the dope upon drying would appear rough and uneven.

After the two base coats are put on, two additional coats of the same type of dope are then applied by means of a spray gun. The dope is first reduced with the proper reducer to a spraying consistency. These coats are then followed by two spray applications of pigmented dope, either of the enamel type or of the aluminum bronze powder type. In each instance the clear dope is used as a base, to which may be added the necessary coloring matter to approximate the desired shade. Sometimes a lustrous top coat is applied directly over the last application of pigmented dope. For the lustrous finish the writer recommends a top coat in which 70 per cent of the clear dope is mixed with 30 per cent of the pigmented dope and applied by spraying. The pigment is added to retard the effect of the actinic rays of the sun, which would hasten the breaking down of the clear film if used as a lustrous top coating.

On the all-metal plane of the future the ultimate type of protective coating will, in all probability, be compounded on a nitrocellulose base which will give the necessary protection of the surface, and at the same time add to the beauty of the craft.

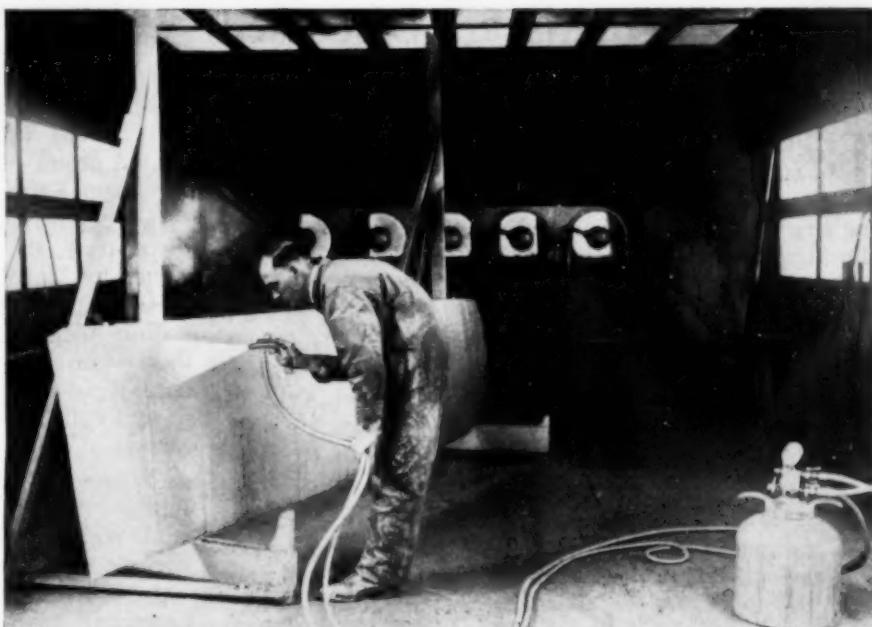
A dope of the cellulose nitrate variety is also commonly used as a protective coating for the gas bags of lighter-than-air craft, although sufficient softening medium is added to give a film that will not shrink upon drying. The bags are top-coated with aluminum bronze powder,

mixed with the clear dope. In the finishing of such craft as dirigibles of the rigid type, which are, of course, much larger than balloons, the method of finishing would necessarily entail an entirely different schedule. It is especially desirable to have a finish as nearly non-flammable as it is possible to produce, so to this end a cellulose acetate dope is usually recommended. Keeping in mind the vastness of the modern dirigible, the finishing schedule offers a serious problem. For example, in coating a craft the size of the *Los Angeles*, the services of a small army of men would be required, and scaffolding must necessarily be erected for the workmen in applying the dope.

The writer recommends the following schedule for applying finish to a dirigible: Two coats of a grade of cellulose acetate of the variety approved by the U. S. Government are first applied directly to the cloth by hand brushing. Reasonable time is allowed between the coats to insure drying and proper penetration of the dope. These two coats are followed by two more of the same material, applied by means of a spray gun. The material must necessarily be reduced to the spraying consistency by the addition of a special thinner made with the cellulose acetate solvents and diluents.

In addition to careful control of the viscosity, it is essential to maintain proper air pressure, and this is no easy task when one considers that a pressure feed-cup type of air gun, which is the best to use for this purpose, will entail an enormous length of rubber hosing for finishing such a craft. It is further essential that the type of spray gun be employed that will insure perfect atomization. The sprayed coating must be thoroughly wet, and the path covered by the spray gun operator must be of even width so as to deposit a uniform coating on all portions of the cloth. The next two coats are made of the clear dope, to which is added finely divided aluminum bronze powder in the approximate proportion of one pound to a gallon. The aluminum powder protects the fabric from the sun, which would otherwise break down the clear acetate coating, liberating free acids that might attack the fabric. To increase the smoothness of the finish, a coating of cellulose acetate, to which has been added 4 oz. of aluminum bronze powder per gallon of acetate dope, may then be sprayed over the last bronze powder coating.

Another satisfactory finishing schedule is one in which



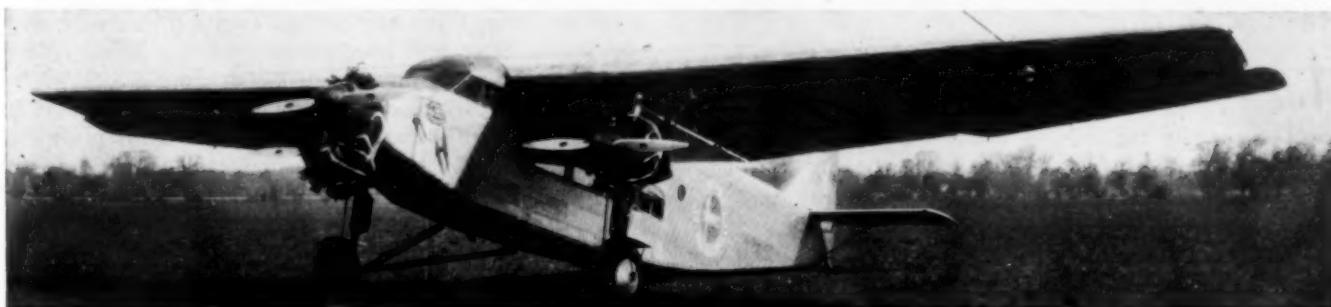
From Ewing Galloway, N. Y.

Spraying a Pyroxylin Finish on an Airplane Wing in the Factory of the Glenn L. Martin Company in Cleveland, Ohio

a cellulose nitrate, of the type used in coating balloons, is recommended. Two brush coats of cellulose acetate are applied as in the first schedule, followed by two spray coats of special dope containing a softening medium. This operation is followed by two spray coats of the cellulose acetate dope containing 1 lb. of aluminum bronze per gallon of dope. These applications are followed by cellulose acetate dope with 4 oz. of aluminum per gallon of base, which is the same top coat as previously recommended to obtain final smoothness of the surface.

Airplanes of all-metal construction, when used for land flights, need not necessarily be given protective covering, but with the advent of lengthy flights overseas and along the seaboard, protection of metallic parts against sea water and salt air is essential to the life of the craft. It has been found that an all-metal plane need only be washed occasionally with a weak alkali to render it presentable. This refers only to a metal plane, however, to which finish has not been applied. The object of applying lacquer colors would be to act as a protective coating and to beautify the lines of the craft.

The aviation industry, now in its infancy, may be expected to continue its spectacular growth. Likewise the chemical engineer may be expected to contribute to the development of better fuel and better materials of construction, but no opportunity offers more immediate promise than in the further development of materials and methods of finishing.



Photograph furnished by Ford Motor Company

A Modern All-Metal, Tri-Motored Plane Owned by the Standard Oil Company of Indiana and Constantly Used by Its Officials for Visiting the Outlying Oilfield and Refinery Properties of the Company

"Corrosion Fatigue" Discussed at A. S. T. M. Meeting

IMPORTANT DISCOVERIES concerning the effect of corrosion and corrosion inhibitors on the endurance of metals under repeated stresses were presented at the Summer meeting of the American Society for Testing Materials, held in Atlantic City, June 25 to 29. Two papers, one by D. J. McAdam, Jr., Metallurgist of the U. S. Naval Experiment Station at Annapolis, and the other by F. N. Speller and his associates, I. B. McCorkle and P. F. Mumma, all of the National Tube Company, brought out the most recent findings in the field of corrosion-accelerated fatigue and the lessening of such accelerated tendencies, respectively.

ASUMMARY of previous knowledge of "corrosion fatigue" occupied part of the paper by Speller and his associates. A study of ferrous metals indicated definitely that there is a limiting stress, at or below which the material may be cyclically stressed indefinitely without apparent injury—the so-called "fatigue" or endurance limit. Experiments by McAdam had already shown that under certain conditions corrosion has a marked influence in lowering the resistance to fatigue of metals under cyclic stresses, especially when corrosion and cyclic stresses occur simultaneously. This has been termed "corrosion fatigue."

Ordinary fatigue tests in air have established a general relationship between the tensile strength and the endurance limit under fatigue. Corrosion-fatigue, however, according to the work of McAdam, is markedly distinguished from ordinary fatigue and is controlled by different factors. The results of his experiments show: (1) that even slight corrosion with fatigue may cause failure at stresses far below the ordinary endurance limit; (2) corrosion of the unstressed metal prior to fatigue usually does much less damage in lowering the resistance to subsequent fatigue than corrosion *combined* with fatigue; (3) "corrosion-fatigue" depends more on the tendency of the metal to corrosion (especially in the form of pitting) than on its physical properties, heat treatment, or chemical composition, except in so far as the latter have a marked effect on the rate of corrosion; and (4) that cyclic stress greatly accelerates local corrosion when the stress is over a certain amount.

The rate of corrosion penetration under cyclic stress is greatly accelerated, probably by interference with the formation of protective coatings, electrolytic effect of stress or strain and local variations of stress in adjacent sections, variations in temperature, and to electrolytic concentration cells set up in minute fissures in the metal or on the metal surface, due to local variations in oxygen concentration.

THE AUTHORS then go on to say that ordinary corrosion may be prevented by reducing the action of the reagent, by the use of suitable protective coatings, or by increasing the corrosion resistance of the metal. This paper deals primarily with the use of a typical corrosion inhibitor to reduce reagent action.

The material used for all tests was taken from a single bloom of basic open-hearth steel containing 0.35 per cent carbon, 0.79 per cent manganese, 0.028 per cent sulphur and 0.014 per cent phosphorus. The tests were carried out in a rotating beam testing machine, with the

specimen completely surrounded by corrosive water which was run on to it continuously. The water duplicated Pittsburgh tap water in effect. Certain of the tests were made by adding 200 p.p.m. of sodium dichromate to the water to act as an inhibitor.

One group of tests established the behavior of oiled specimens protected from corrosion. Uninhibited corrosion tests followed, confirming, as did the protected metal tests, the results which had previously been reported by McAdam. Runs which were then made using the inhibitor-containing water showed that 200 p.p.m. of sodium dichromate was sufficient, for the water used, to prevent corrosion and to give the specimen an endurance limit equal to that of the oiled sample. Further tests, localizing the corrosion, showed that the localized corrosion was very severe and, in some cases, sufficient to completely neutralize the protective effect of the inhibitor. Other tests of localized corrosion showed results intermediate between the oiled and the normally corroded samples.

In conclusion, it was stated that there is a need for protective coatings which will not break down under cyclic stress.

DR. McADAM'S paper greatly extended the disclosures in his earlier communications. Particularly, he showed that torsional fatigue tests produce incipient cracks of cross shape, on 45 deg. axes with the length of the specimen. He brought out clearly the relations between corrosion pitting and notching and stress concentrations of destructive quality. It had previously been shown that, for most metals, severe stressless corrosion prior to fatigue is much less damaging than even slight corrosion simultaneous with fatigue. For some aluminum alloys, however, corrosion prior to fatigue is about as damaging as corrosion simultaneous with fatigue. Corrosion, in any case, results in the formation of pits. If the initial stress is below the endurance limit, such pit formation is assumed to be due to electrolytic solution pressure, not to fatigue. The electrolytic solution pressure that causes the pitting, however, is not the solution pressure of stressless corrosion, but is possibly an enhanced solution pressure due to the cyclic stress.

PIT or notch formation, however, ordinarily decreases asymptotically with depth. Notch-depth limitation is probably due chiefly to decrease in intensity of corrosion at the bottoms of the notches with increase in length of the column of corrosion products through which the electrolyte must diffuse. Three kinds of water—salt, carbonate and soft—showed the effect of cyclic stress between zero and the notching limit to be about the same. Notch depth limitation, however, is much less effective in salt water than in the other two kinds.

The notching limit was further found to decrease with increase in time and number of cycles. Nevertheless, it is little affected by physical properties, but is affected by the corrosion resistance of the metal. Other tests lead to the conclusion that the corrosion-fatigue limit is practically unaffected by variation in diameter or thickness of specimen, provided the diameter is large compared with the depth limit of notches. In general, for carbon and high-strength alloy steels, the relation between cyclic stress-range and notch depth, notching limit and corrosion-fatigue limit, are independent of the size or thickness of specimen, provided the diameter is large in comparison with the notch-depth limit.

Drying Sulphur Recovered from Manufactured Gas

Recovered sulphur, either as a paste or a dust, is unexcelled for many agricultural purposes

By K. N. Cundall

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AT THE PRESENT TIME, in many of the larger gas plants, particularly on the West Coast, there is being recovered a remarkable variety of sulphur which has recently been found to be very effective in agricultural work. This sulphur has unusual properties as an insecticide and fungicide while, in addition, by reason of its extremely small particle size, it shows marked activity in the neutralization of alkaline soils. In view of these properties, and the possibility of advantageously disposing of recovered sulphur sludges, its drying has presented a very unique and interesting problem.

A previous article (*Chem. & Met.*, March, 1927, page 142) gave a description of the process developed by the Pacific Gas and Electric Company for the removal of sulphur compounds from gas and the recovery of the sulphur. This process is based upon the original Koppers liquid purification treatment, involving the use of sodium carbonate for fixation of the hydrogen sulphide in the gas. The solution of NaHCO_3 and NaHS , which results from the purification step, is recovered and the sulphur liberated as a sludge by catalytic oxidation, using a nickel catalyst. The precipitated sulphur is in very finely divided form and contains about 55 per cent of water.

At the present time, the principal users of sulphur are not familiar with the recovered product, and until it can be sold on its own merit it has been found necessary to dry the sludge and then either sell in competition with commercial brands in a lime-sulphur mixture or as a dry gray dusting powder. It is principally for this reason that the drying is resorted to despite the value of the sulphur as a paste. It has been demonstrated that it is possible to dry this sludge several different ways without injuring its toxic properties. Furthermore, drying obviates the necessity for paying freight on a large amount of water.

THE FOLLOWING covers the processes which we have tried in drying or partially dehydrating the sulphur sludge. The utilization of this new product is also discussed. The investigations were carried out on a semi-works scale so as to obtain as complete technical and economic information as possible with several drying methods, so that market demands for different kinds of products could be quickly met.

Sulphur Digesting—One market required a sulphur containing less than 30 per cent of water. To produce this, the sludge was digested in a steam heated pressure vessel with consequent reduction in water content and

partial purification of the sulphur. This treatment caused an incomplete melting of the sulphur and darkened its color. When the paste had been discharged through an orifice near the base of the digestor shell, it was found that it would drain to less than the prescribed minimum of water. Two digestors, constructed for the purpose at the Potrero plant in San Francisco, are shown in Fig. 1. Each was $3\frac{1}{2}$ ft. in diameter and 9 ft. high. They were placed on end, insulated and arranged for the injection of superheated steam at several points around the lower periphery. The top of each carried a quick lifting valve of generous dimensions. In operation, a 3,000 lb. batch of the wet paste containing about 55 per cent water was charged into the digestor through a door at the top, which was then closed. By the injection of live steam, the temperature was raised to about the melting point of sulphur, 119 deg. C., at which point the pressure in the digestor was about 60 lb. per square inch. During the digesting a certain amount of free sulphuric acid was formed. This was neutralized by the addition of the chemical equivalent of soda in order to protect the digestor from corrosion. The inside surfaces of the digestors were also periodically coated with resistant paint.

After about twenty minutes or more the "decomposi-

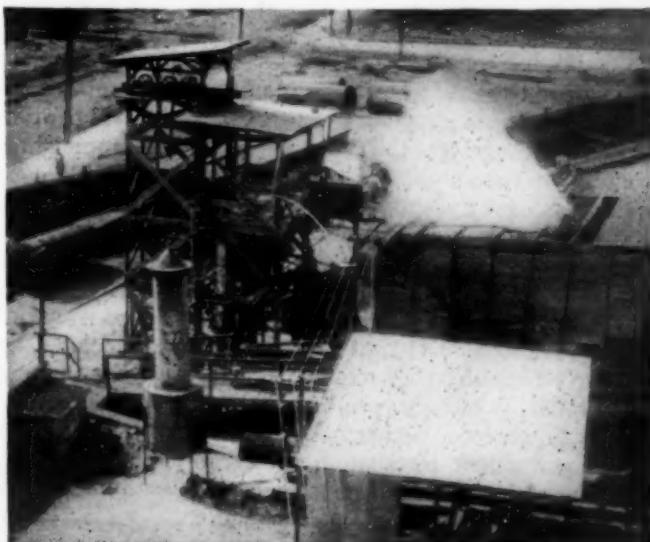


Fig. 1—Pressure Digestors and Rotary Drier Built for Drying Recovered Sulphur Sludge

The digestors appear at the left in the rear. At the right rear are the draining bins. The rotary drier is in the foreground.

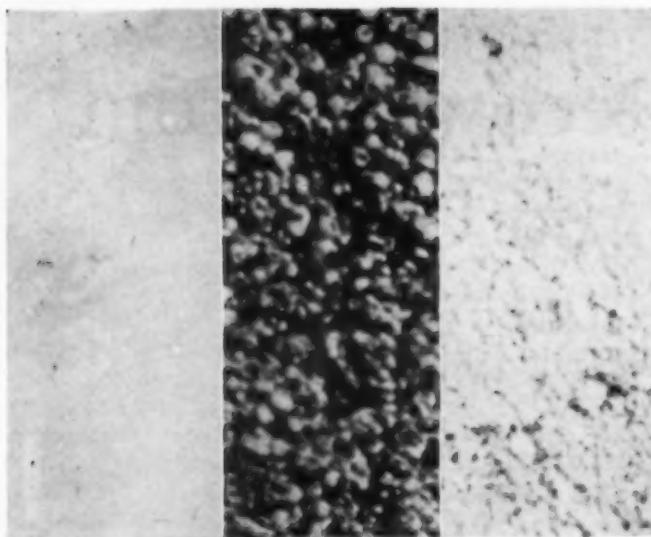


Fig. 2—Recovered Sulphur Sludge in Various Forms

The panel at the left shows the sludge as it comes from the gas purification plant. The sample in the center is one of "black sand" as produced by the digestors. The "gray sand" at the right is a product that has been flocculated by boiling.

tion" was completed. The lower valve was opened and the sulphur discharged through the air into a bin with the water which had separated during the melting. Twin bins were used so that one batch of sulphur could drain while the other bin was being filled. In using twin digestors, one of which could be heated while the other was loaded and operated, a total of 25 carloads of the digested product was produced in about five months. In addition to the partial drying accomplished in the digestors, the sulphur was also purified to some extent. The average analysis of the material shipped showed a total sulphur purity of over 94 per cent, an ash content of about 2½ per cent and water content reduced to about 25 per cent. The material was found to be excellent for lime-sulphur work.

In this treatment, the emulsion of water and sulphur is broken and the sulphur is flocculated as is shown in the center panel of Fig. 2. The material, after it discharges into the bin, contains practically pure sulphur with sodium and iron salts as impurities in the entrained water. By erecting a sprinkler to spray hot water over the bin, it is possible to wash out most of the undesirable soluble sodium salts.

THE COST of drying sulphur in this semi-experimental digesting plant was between \$6 and \$11 per ton. This wide range was the result of differences in moisture content of the sulphur as well as varying climatic conditions. A gray sulphur sludge of 40 per cent moisture, for example, can be treated at a very low cost in dry weather. The labor required to transport the sulphur from the pile to the digestor has been costly in the experimental plant, but could be greatly reduced with full scale operation. The heat consumption, as calculated by Napier's formula, was about 7,000 lb. of steam per ton of sulphur, which is probably high. There is every reason to expect a decided improvement in overall costs for a permanent installation, preferably placed at the shipping point and conveniently located with regard to the source of supply.

Rotary Driers—While the foregoing production was going on, experiments were conducted to determine the feasibility of using a gas-fired rotary drier. It was intended to produce a nearly dry sulphur, which could

be sold at a much better price than the granular "black sand" produced in the digestors. Sulphur dried in a rotary drier could be used for dusting purposes and thus retain the fine division and high toxicity so valuable in agricultural work. After obtaining figures from a small experimental unit, a large rotary drier was constructed and placed in operation beside the digestors. This machine is also shown in Fig. 1. It consisted of a 24-in. riveted pipe, 35 ft. long, placed on rollers so as to have a slope of 3 in. in 20 ft. The drier was rotated at 18 r.p.m. It was equipped with a blower discharging through a 16-in. combustion tube placed into one end of the drier. The machine was gas-fired through the same tube and fed, when wet material was used, from an inclined hopper placed over the pipe. A chain ran the length of the drier on the inside to aid in breaking up the sulphur lumps. In about two months, more than 175 tons of dried sulphur was produced. The material was passed through the machine twice, as the first run brought the water content down to 18.7 per cent, while the second yielded a product containing about 2 per cent water. This was dry enough so that it could be sold as dusting sulphur.

FAIRLY uniform drying resulted, as is shown by Table I, which gives the moisture drop along the length of the tube, during the initial run. The average

Table I—Rotary Drier Drying Rate

| Remaining Travel, Feet | Per Cent Water | Remaining Travel, Feet | Per Cent Water |
|---------------------------|-------------------|---------------------------|-------------------|
| 35 | 34.5 | 17 | 26.0 |
| 33 | 33.0 | 9 | 22.0 |
| 25 | 28.0 | 0 | 18.7 |

temperature during this first run was 650 deg. F. and during the second, 450 deg. It was necessary to use great care to prevent overheating at any point in the drier owing to the danger of melting, and possibly firing, the sulphur. The infrequent fires that were experienced were easily put out by increasing the feed of wet sulphur at the upper end of the drier. The temperature of the air leaving the cyclone collector at the discharge end of the drier was 150 deg. F., with a relative humidity of 70 per cent.

On the whole, the rotary drier was successful, but it was necessary to feed the material through twice to get a bone dry product. This involved additional labor and might have been avoided if the cylinder had been twice as long. The expense of drying was about equal to the cost of treatment in the digestors. The only objection to this process lay in the tendency of the sulphur to be injured for insecticide purposes by too rapid or too high heating. It was previously determined that the added toxic effect of some factor in the sulphur could be destroyed by this means. Recourse was therefore had to a tunnel drier in order to eliminate the possibility of impairing toxicity.

Tunnel Driers—The first step in the next investigation was to secure the use of an experimental drier at the University of California, and from this to obtain approximate figures for use in drying the material on a commercial scale. As this oven was electrically heated and thermostatically controlled, some very good data were obtained. The curves shown in Fig. 3 are characteristic of the removal of moisture from sulphur in a drier of this type. It will be noted that the drying time with Monel screens to support the cake was considerably faster than with wooden slats.

Having obtained sufficient data from this small drier, a nearby chemical plant which contained the necessary equipment for tunnel drying was leased. The apparatus, shown as a flow diagram in Fig. 4, consisted first of an agitator, into which the sulphur paste was dumped and mixed to a 10 per cent slurry. The slurry was then pumped into a reserve tank and there heated with agitation to 100 deg. F. From here the solution was pumped to two 22-in. plate-and-frame filter presses equipped with an extra linen cover over each filter cloth. A 1½-in. cake was built up on the cloth after the application of pressure up to 50 lb. The press was then opened, the cake transferred to wooden trays which fitted in racks on a car, after which the car was rolled to the tunnel drier.

THE DRIER was 20 ft. wide by 50 ft. long and 7 ft. high (see Fig. 6). It held 24 cars on three tracks. The cars held 40 trays each, which, when loaded with 1½-in. dry cake, contained 440 lb. of sulphur per car. The tray weights were 29 lb. wet and 11 lb. dry. The drier was operated continuously, with wet cars added at one end and dry cars taken from the other. The drier capacity amounted to 7 tons per day on the dry basis, with a drying time averaging 16 hours. Steam was supplied to the heating coils at 120 lb. pressure. Circulation was maintained by seven fans, designed to give a zig-zag travel to the air before it was finally discharged to the atmosphere by another fan in a stack at the center of the drier.

Air temperatures at the wet end were varied in the beginning through a range of from 190 to 160 deg. F., until a final safe temperature of 167 deg. was adopted. The dry end temperature was maintained at 140 deg. throughout. Temperatures in the stack showed the wet bulb reading to be about 100 deg. and the dry bulb 160 deg. Based upon atmospheric air at 57 deg. F. and 79 per cent relative humidity, calculations showed that, with drier conditions as above, the theoretical steam consumption was 1,732 lb. per hour. Air consumption was calculated as 8,655 cu.ft. per minute. Actual steam consumption was found to be about 1,978 lb. per hour, giving a drier efficiency of 88 per cent. The sulphur dried per square foot of tray space per hour was found to be 0.204 lb.

An oxidation and sublimation test was made at the drier stack by aspirating a measured volume of air through two bottles containing dilute KOH. The solution and washings were tested for total sulphur, but the quantity was very small. An average of two tests gave only 0.0413 grams of sulphur per 11 cu.ft. of air. However, sufficient sublimed sulphur collected in the stack during the whole drying period so that, when the temperature was later increased for drying lithopone, the sulphur flashed, with but slight damage, however.

DIFFICULTY was at first experienced because there was some oxidation of the sulphur with the formation of slight acidity which damaged the sacks used for shipping the product. This trouble was overcome by breaking up the lumps and allowing the sulphur to cool before sacking. In general, this method of drying sulphur to prepare it for the market is very satisfactory. The re-pulping treatment will insure a sulphur of over 94 per cent purity with an ash content of below three. Over 250 tons of dry sulphur were produced in this plant in less than two months. Enough data was secured to permit the calculation of the probable cost per

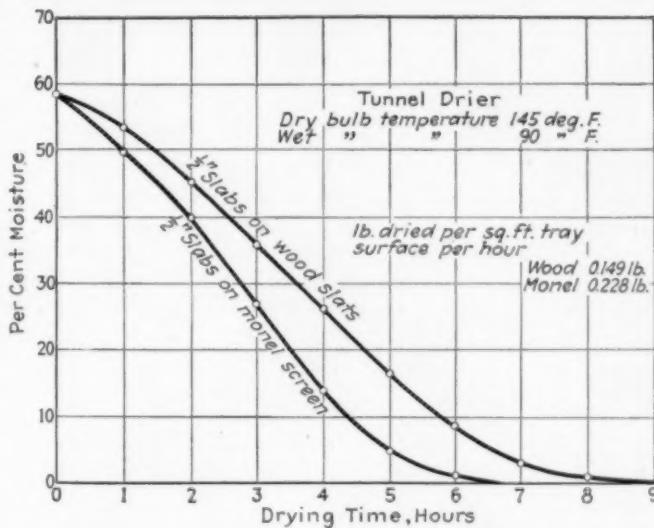


Fig. 3—CHARACTERISTIC CURVES FOR DRYING SULPHUR IN ELECTRIC DRIER

ton of sulphur in such a drying plant. It was estimated that the cost of drying sludge in this type of tunnel drier should be between \$9 and \$14 per ton.

In all three types of drying so far discussed, a profit was returned, even though the processes were primarily experimental. A summary of the three methods showed that the tunnel drier turned out the best material. The most economical way of handling the sulphur would be to pump it from the separator in the gas purification plant into a continuous filter, discharging the cake to a rotary drier. In this way little or no labor would be required. On the other hand, if there should be a demand for different kinds of dried sulphur, one gas plant might produce one kind, "black sand" for instance, while another plant produced the gray. The capital expenditure would be lower and the profits higher. With the higher price quoted on dusting sulphur, the tunnel dried material seems to have the greatest possibilities.

Separation by Boiling—A fourth method of separating moisture from the sulphur has great possibilities, although at present it has not been tried out on a commercial scale. It consists in boiling the gray sulphur sludge, as it comes from the separator (containing about 20 per cent solids), for a short time, causing the sulphur to coagulate and drop to the bottom. The right-hand panel of Fig. 2 shows this material in comparison with the original gray sludge in the left-hand panel and the digested sulphur at the center. Ordinary gray sulphur shows very little tendency to settle on standing. The boiled material, however, settles rapidly, leaving clear

Table II—Draining Rate Data

| Duration of Drain Gravity filtered | Air Temperature | Per Cent Water | |
|------------------------------------|-----------------|------------------------------|----------------------------|
| | | 20 Per Cent Sludge, Unboiled | 20 Per Cent Sludge, Boiled |
| 10 min. | 55 | 79 | 46 |
| 4 hrs. | 56 | 64 | 45 |
| 24 hrs. | 54 | 54 | 39 |
| 48 hrs. | 51 | 51 | 37 |
| Suction filtered | | | |
| 10 min. | 55 | 70 | 29 |
| 4 hrs. | 56 | 61 | 28 |
| 24 hrs. | 54 | 58 | 27 |
| 48 hrs. | 51 | 54 | 25 |

liquor at the top, which can be drawn off and the coagulated sulphur removed, drained and rapidly sun-dried. This process may be accomplished at a cost of less than \$5 a ton for treatment. Table II shows the drop in water content after boiling the sludge for approximately 20 minutes.

The tabulation makes it evident that after a very short treatment, and at small expense, a sulphur is produced

which is dry enough to be used in lime-sulphur work. The sulphur coagulates to form false bodies which are very easily broken up again when subjected to further drying or grinding. Some question, however, was raised as to whether or not material treated in this way would lose its toxic properties. A sample, examined by Professor de Ong, Entomologist of the University of California, was found to show very little loss in toxic activity. Spores of Fungi Botrytis and Monilia, in water containing 0.1 per cent of either the boiled or unboiled sulphur, gave germination tests averaging 0.85 per cent germination for the unboiled, and 1.2 per cent for the boiled as compared with 47 to 62 per cent without sulphur.

IT WAS FOUND that, in boiling the sludge before it was pumped to a leaf filter, a reduction of over 10 per cent could be made in the water content of the cake on the leaves of the filter. Pressures up to 100 lb. per square inch were used with excellent results. Some of the filtered sludge was re-pulped as a 10 per cent slurry and after re-filtering was very low in ash content and consistently below 40 per cent in water content.

Drying by Centrifuge—The centrifuge, as a means of drying sulphur sludge, was first tried because it seemed to offer several advantages, notably, increased filtering rate, ease of washing, no air requirement for drying, automatic unloading, low labor cost and a drier cake. The centrifuge used was a laboratory model with a brass basket, 12 in. in diameter and 6 in. deep, operated at 2,200 r.p.m. The first centrifuge tests were made with a re-pulped slurry containing, on an average, 12 per cent solids. All washing was done with water at a temperature of about 170 deg. F. The average filtering rate for all runs in this series was 0.5 gal. per minute per square foot of filter area. The rate was not as high as anticipated which was probably accounted for by the colloidal nature of the material. The ash in the centrifuged cake averaged about 1½ per cent as against over 3 per cent for filter press cake using the same feed, but without washing.

WHILE the above tests are very encouraging, they were made on re-pulped material. In order to duplicate leaf filter operating conditions, the centrifuge was used with a sludge having but 2 per cent solids or less. This required a large volume of filtrate to obtain a good cake and probably accounts for the slightly higher filtration rate, which averaged 0.86 gal. per minute per square

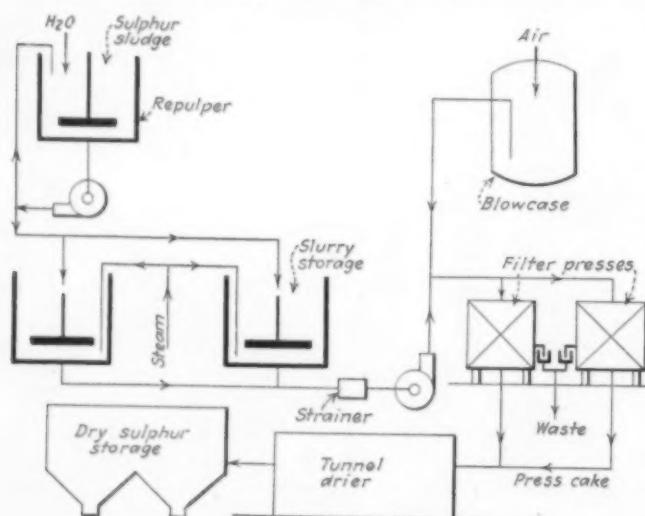


Fig. 4—Flow Chart of a Plant for Drying Sulphur Sludge by Means of a Tunnel Drier

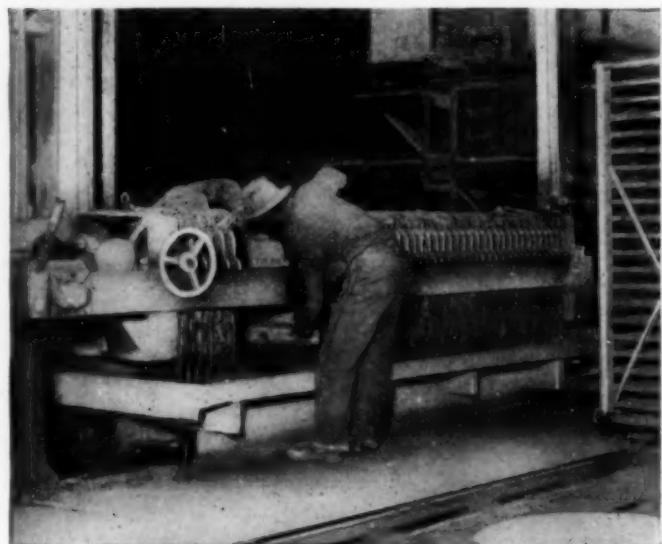


Fig. 5—Filter Press Used for Preparing Cakes of Sulphur Sludge for the Tunnel Drier

foot of filter area. The corresponding figure on boiled sludge was 1.02.

It was found that the average moisture content in the centrifuged cake, without boiling, was 52 per cent, while with boiling it was 30.2 per cent with a corresponding ash content of 2.47 per cent on the dry basis. The maximum thickness of the cake obtainable was 1½ in. It has been demonstrated that boiling increases the filtering rate and the possible weight and thickness of cake, while it decreases the moisture content considerably, and the ash slightly. These results are indicative of the possibilities in boiling the sulphur and in filtering it with the centrifuge.

Utilization of Sulphur—The utilization of recovered sulphur covers a wide range of possibilities. It has been definitely shown that this sulphur is extremely toxic to nearly all the plant blights usually treated with sulphur. Tests conducted by the University of California have shown that this sulphur has some ingredient in its make-up which renders it many times more effective than the ordinary commercial brands of sulphur. Tests have isolated this ingredient and a report on this phase of the work is to be published.

SULPHUR is used in agriculture in a number of ways. A summary of these applications is given below. Sulphur recovered from manufactured gas has reacted admirably to nearly every application in which ordinary sulphur can be used.

- 1—The annual consumption of sulphur for orchards, dipping livestock and dusting purposes in California alone is now 5,000 to 6,000 tons.
- 2—Calcium and sodium polysulphides are the sulphur compounds ordinarily used for orchard spraying and stock dipping. The compound is applied to the dormant fruit tree as a 10 per cent concentration of 35 deg. Bé. concentrate, for San Jose scale, peach twig borer and to control the fungi causing peach leaf curl, peach blight, apple mildew, pear scab and so on. It is also used as a summer spray for red spider, rusts and mildews, and on citrus trees for scale insects and thrips. Sulphur dusts are used principally in vineyards as a control for grape mildew. The greater part of the vineyard acreage is dusted one or more times per year.
- 3—Dusts are also used on truck crops such as lettuce, cantaloupes and asparagus, and also for red spider in orchards.
- 4—Sheep are dipped as a control for scab. This practice

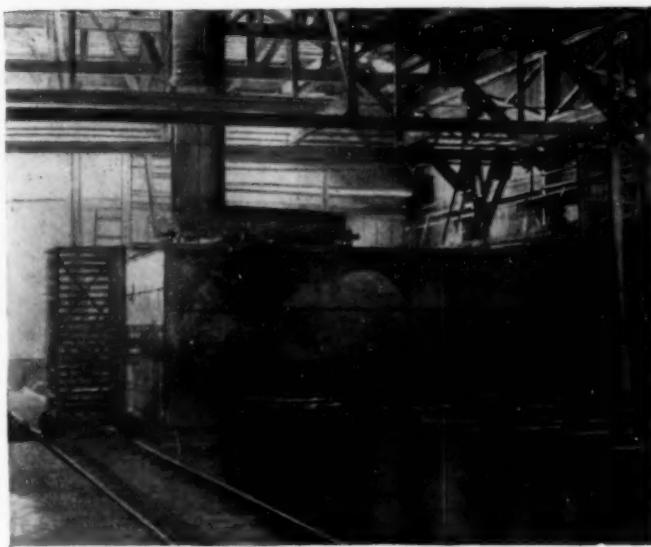


Fig. 6—Tunnel Drier of 24 Car Capacity Used for Drying Recovered Sulphur Sludge

- has been followed so extensively in the Western States that they are now almost free from this affection.
- 5—Large quantities of sulphur are used annually in bleaching hops and cut fruits—apples, pears, apricots and peaches.
- 6—A new but rapidly increasing agricultural use for sulphur is that of soil fertilizer and in neutralizing alkaline soils. The consumption for this purpose is increasing rapidly in the Pacific Coast States, where "alkali" is prevalent. The basalt soil of the Northwest has been found to respond very favorably to sulphur as a fertilizer.
- 7—Sulphur as a soil fungicide is now receiving much attention, particularly in Eastern United States and in England. By changing the pH of the soil solution, certain harmful organisms, for example, the fungus causing potato scab, some of the soil-inhabiting fungi, and insect larvae such as wire worms, are inhibited or forced to find a more congenial environment.
- 8—Sulphur also aids in flocculating the soil particles, thus making the soil more permeable to water.
- 9—Sulphur, as a fertilizer, is converted to sulphuric acid by the aid of oxidizing bacteria. The action of the acid is to convert insoluble potash, phosphate and calcium compounds into forms available for plant use. There is also some action on nitrification. Plants absorb sulphur more readily in the form of calcium sulphate.

Recovered sulphur, in addition to containing a very toxic material as an "impurity," has the added advantage of being made up of particles of almost colloidal size. The average size of the recovered sulphur particle is many times smaller than that of the smallest commercial brand of sulphur. Table III gives figures on sizes, obtained in recent measurements. Most of the recovered

sulphur has been applied in districts ranging from Mexico to Canada, east to the Mississippi, and through the cotton belt in the South. It has been interesting to note the rapidity with which alkaline soils may be reclaimed through comparatively small amounts of recovered sulphur. One user reports that he was able to plant alfalfa within three months time after an application, when ordinarily a whole season would have elapsed before suitable results could have been obtained. Tests made in two sandy California soils, at Oakley and Fresno, showed the speed of oxidation to sulphate of recovered sulphur as compared with two commercial brands. The recovered sulphur was from 20 to 30 per cent more nearly oxidized within a three months period than were either of the two commercial grades which were simultaneously tested.

Additional tests on three species of red spider showed that recovered sulphur has remarkable killing power as well as excellent spraying qualities. Considerably less is required of the recovered than of the commercial grades. Other tests have failed to produce another form of sulphur which is superior to the recovered product for use as an insecticide and fungicide in a whale oil soap. Consequently, with results thus far so satisfactory, further work will be gladly undertaken.

IN CONCLUSION, it is noted that methods of sulphur recovery are now reliable and feasible, and that various kinds of drying equipment may safely be used to dry the sludge so produced. Dried sulphur has an assured sale and its drying is entirely justified.

These developments in the preparation of recovered sulphur for the market are being carried on by the Pacific Gas and Electric Company through its production and research departments. E. N. Percy, under Vice-President W. S. Yard and Engineer Frank Wills, directed the work, assisted by Professor E. R. de Ong, C. L. Chapman and K. N. Cundall.

Germany Now Hydrogenating Brown Coal on a Commercial Plant Scale

OF ALMOST as great interest as the German nitrogen fixation and fertilizer manufacture is the large experiment which the I. G. is making in the hydrogenation of coal at the Merseburg works. Here the Bergius process, modified it is reported by the addition of a catalyst, is being operated on a large scale. The work was logically undertaken at Merseburg because the raw materials—coal and hydrogen—were available at lowest cost. Further it was possible to draw upon the extensive experience already gained in the technology of high-pressure, high-temperature processes.

It is understood that the hydrogenation process has not yet been developed to the profitable stage, but that the prospects are favorable for financial success this year. However that may be, coal is being processed at the rate of 1,000 tons per day. It is finely incorporated with heavy oil to the consistency of putty, pumped into large containers and treated with hydrogen at high temperature and pressure. At the end of the contact period the mass is practically liquefied. The liquid is filtered from the ash and unconverted residue and distilled. At present only one fraction is recovered, namely that suitable for motor fuel. The heavy oil remaining is incorporated with fresh coal and returned to the hydrogenation process.

Table III—Sulphur Particle Sizes

| Size Groups Microns (0.001 mm.) | Per Cent of Particles in Each Size Group | | | | |
|---------------------------------------|--|-------------------|----------------|-------------------|----------------------|
| | Flowers | Ground Flowers | Ground Roll | Precipi- tated | Recovered Sulphur |
| 1—15 | 0 | 10 | 10 | 25 | 100 |
| 25—50 | 10 | 35 | 35 | 50 | 0 |
| 50—100 | 25 | 55 | 30 | 25 | 0 |
| 100—200 | 55 | 0 | 20 | 0 | 0 |
| 200 and above | 10 | 0 | 5 | 0 | 0 |

sulphur particles are smaller than 15 microns and many are too small to be measured.

Recovered sulphur has been tried recently on such blights as asparagus rust, peach, apple and rose mildew and rust on prunes. Additional work has been done with the cotton leaf hopper and lettuce mildew, and as a soil fertilizer and neutralizer for "black alkali." The

Making Pure Tungstic Oxide Involves Many Unusual Plant Problems

Selection of corrosion resisting materials of construction to prevent contamination, resulted in use of stoneware, rubber-lined equipment, wood tanks and special alloys

By W. B. Gero and C. V. Iredell

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MANUFACTURE of tungsten metal, for use in incandescent lamps and electron discharge devices, requires a tungstic oxide of very high purity and definite physical characteristics. Since the physical properties of the oxide are influenced by the conditions under which the various steps of purification are carried out, as well as by the method of purification, it is the purpose of this paper to describe a process and particularly the equipment suitable for the production of tungstic oxide of high purity and uniformity.

In the experimental and development work connected with this project, it was necessary to design equipment to meet a number of unusual conditions, and it is believed that many of these features will find application in similar problems in other of the chemical engineering industries. It will be noted that the installation possesses exceptional flexibility. On account of the variations in the physical requirements for tungsten metal for different purposes, it was found desirable to set up equipment capable of permitting modifications in the process of purification and which would also be suitable for the manufacture of other tungsten products.

Most of the generally used methods of decomposing the wolframite ore fall within one of the following classes (Smithells "Tungsten," 1926, pages 9-13):

(a) Fusion with alkaline carbonates (Jones, *Chem. & Met.*, vol. 22, pages 9-15, 1920, and Gordon and Spring, *J. Ind. Eng. Chem.*, vol. 16, page 555, 1924).

(b) Fusion with sodium sulphate and coke, or similar mixtures.

(c) Digestion with caustic alkalis (U. S. patent 1,293,117).

(d) Digestion with acids. (British patent 10,117, 1915).

Classes (a) and (c) are of the greatest importance commercially. In the process outlined below, the extraction has been made by digesting with caustic soda. The extraction and purification processes may be summarized as follows:

1. The raw material used is Chinese wolframite ore concentrates, containing 65 to 75 per cent WO_3 . This is crushed and ground to a state of fineness, such that 100 per cent will pass through a 100 mesh sieve and 80 per cent will pass through 200 mesh.

2. The pulverized ore is digested at a boiling temperature with strong caustic-soda solution until decomposition is complete. The resulting sodium tungstate solution is decanted off and the insoluble residue washed with water. The strong sodium tungstate solution and the wash waters are combined.

3. To the sodium tungstate solution thus formed, calcium chloride solution is added. The white precipitate of calcium

tungstate is formed according to the following equation:—
 $Na_2WO_4 + CaCl_2 = CaWO_4 + 2 NaCl$

This precipitate is allowed to settle and washed by decantation until free of soluble salts.

4. The calcium tungstate, suspended in water, is run into an excess of boiling hydrochloric acid, and digested at a temperature near the boiling point. The yellow or orange tungstic acid is formed as follows:—



The tungstic acid is allowed to settle and washed free of soluble impurities.

5. The tungstic acid slurry is run into an excess of ammonium hydroxide and dissolved, forming ammonium-tungstate solution.

6. The ammonium-tungstate solution is neutralized with pure hydrochloric acid. Fine white needles of ammonium para-tungstate are precipitated. These are allowed to settle and washed thoroughly by decantation.

7. The dried ammonium para-tungstate crystals are ignited in order to volatilize ammonia and water, leaving pure tungstic oxide, WO_3 .

LAYING out a plant to produce tungstic oxide according to this process involved consideration of the following general requirements:

1. *Capacity:* Equipment was desired capable of handling one ton of wolframite ore and the tungstic oxide extracted from it, each time a batch was prepared.

2. *Quality:* The tungstic oxide produced must be of the highest purity attainable. Equipment was to be considered with the object in mind of preventing contamination, as well as providing for sufficient washing and dilution.

3. *Labor Saving:* It was desired to eliminate as far as possible all manual labor connected with handling or transferring the material as it passed through the process.

4. *Space Considerations:* This plant was to be installed in one end of a building already partly occupied by other processes. The cross-sectional dimensions of the building were 80 ft. by 17 ft. high with a monitor 20 ft. by 10 ft. high over the center bays. It was necessary to maintain a general passage-way down the full width of the center bays and to protect this passageway from any overflow or leakage from the equipment above.

5. *Material Handling:* In transporting the liquids and semi-liquid slurries, suspensions, etc., the layout of equipment was to be designed with the purpose in view of taking advantage of gravity flow wherever possible.

6. *Elimination of Fumes:* Since this plant was to be located in a steel-frame building it was necessary to provide for the complete elimination of fumes from the various operations. Natural draft was to be utilized for this purpose if possible.

Arrangement of equipment is shown in elevation in Fig. 1. On account of the heavy equipment to be installed and the fact that elimination of vibration was desired, it was necessary to erect a steel structure on foundations independent of the building structure. This

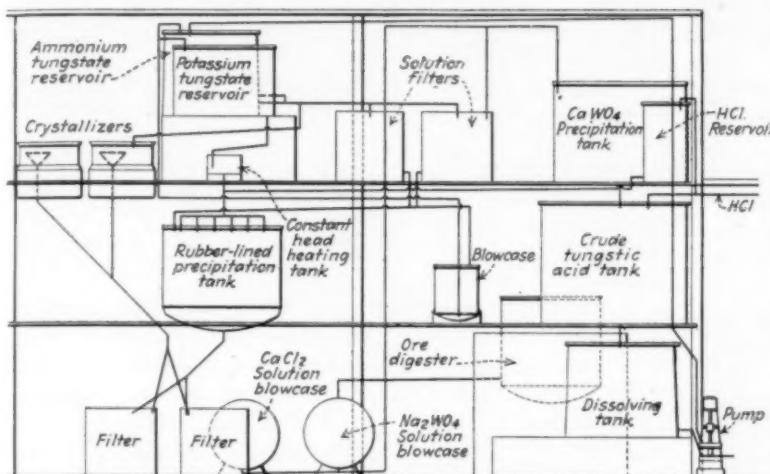


Fig. 1—Elevation of Plant Showing the Equipment for the Extraction and Purification of Tungstic Oxide

consists of two floors and platforms as indicated, each with a dead load carrying capacity of at least 450 lb. per sq.ft. Elevated floors and platforms are covered with $\frac{1}{2}$ -in. steel checkered plates and recovered with a $1\frac{1}{2}$ -in. layer of asphalt cement. Complete drainage is provided for each floor, insuring protection for the passageway underneath.

With the exception of one operation, transportation of liquids has in all cases been accomplished either by gravity or by compressed air. Elimination of fumes has been effected wherever necessary by the use of stacks, taking advantage of natural draft.

The principal problem to be overcome in extracting the tungstic oxide from the ore was to keep the heavy powdered ore in suspension at all times, since once it settled it formed a heavy mat which both plugged the outlets and put heavy strain upon the agitator. For this purpose, the equipment shown in Fig. 2, manufactured by L. O. Koven & Bro., was adopted. The digesting tank has a capacity of 1,100 gal. and is composed of a $\frac{3}{8}$ -in. steel shell with a $\frac{1}{2}$ -in. convex bottom. To the apex of the bottom is welded a $2\frac{1}{2}$ -in. horizontal outlet pipe. Another outlet is provided on the side as shown. The digester is mounted on brackets supported by a 12-in. brick wall. A fire box is provided and three gas burners serve as the source of heat. A 12-in. iron stack ventilates the digesting tank in addition to carrying off the gases from the combustion chamber. A bucket elevator conveys the charge into the digester. The discharge chute of this elevator is equipped with a swinging door which permits of the charge entering the digester but prevents the steam from passing up the chute and wetting the elevator buckets.

For operation, the required quantity of water is added to the digester, the agitator started and the necessary amount of caustic soda charged. Heat is then applied. As soon as the caustic soda is in solution, the calculated quantity of ore is added. Two precautions must be taken before adding the ore and during the digestion, viz., that the agitator must be in motion, and steam must be admitted to the bottom outlet. Otherwise, the ore will settle to the bottom, plug the outlet and it will be impossible to again start the agitator. After digesting until decomposition is complete, water is added to give a definite volume and the gangue allowed to settle. The clear sodium-tungstate solution is then decanted into a steel blowcase as shown. The residue in the digester is leached with water until free of soluble tungstates, and

the leachings added to the strong sodium tungstate solution.

For precipitation of calcium tungstate a piece of equipment was desired in which good agitation could be obtained, and thorough washing by decantation could be carried out, and from which the resulting precipitate, suspended in water, could be drained by gravity. A 2,200-gal. tank (Fig. 3) made with $\frac{1}{2}$ -in. steel shell and $\frac{1}{8}$ -in. steel bottom, was manufactured by L. O. Koven & Bro., and installed for this purpose. The tank is provided with seven 2-in. outlets on the side for decanting and with a 3-in. welded bottom outlet for discharge of calcium tungstate. Agitation is furnished by means of a single blade agitator set $\frac{1}{2}$ in. from the bottom and a 12-in. channel iron extending down one side of the tank.

It was decided to use compressed air to elevate the reacting solutions to the precipitating tank. Individual blowcases were installed for the sodium-tungstate solution and for the calcium-chloride solution. These are of 500-gal. capacity, fitted with a manhole and water, steam and air inlets on top, and a 1 $\frac{1}{2}$ -in. outlet at the bottom. The sodium-tungstate blowcase is also fitted with a gage for indicating the height of the solution as it is being drawn off from the digester. Since a common line to the precipitating tank is used, it is necessary (in order to prevent fouling), to take the precaution of rinsing the line immediately after transportation of each solution. This is accomplished by running water through the line from inlets situated immediately behind each blowcase outlet.

In carrying out this step of the process, the sodium-tungstate solution is first elevated to the precipitating tank, and diluted with water to the required specific gravity. Calcium chloride solution of definite concentration is made up in the second blowcase by dissolving granular calcium chloride in water. In order to facilitate solution and prevent accumulation of solid calcium chloride in the outlet, it was necessary that the calcium chloride be suspended in a $\frac{1}{2}$ -in.-mesh wire basket and agitation of the solution provided by means of air. With the agitator in motion, the calcium-chloride solution is then run into the precipitating tank containing the sodium-tungstate solution. Calcium chloride is added in excess, continuing the agitation during the entire time. The precipitate is allowed to settle, after which it is

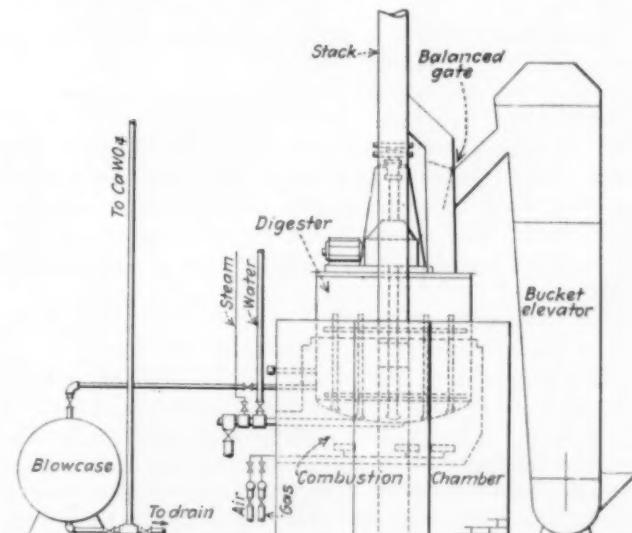


Fig. 2—Equipment in Which the Wolframite Ore is First Digested

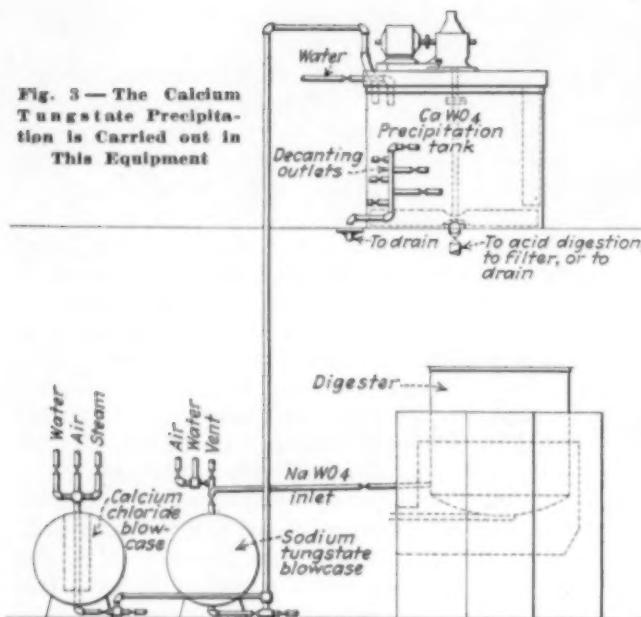


Fig. 3 — The Calcium Tungstate Precipitation is Carried out in This Equipment

washed by decantation until soluble impurities are eliminated.

EQUIPMENT for the preparation of the crude tungstic acid must withstand: (1) Hydrochloric acid of all concentrations, together with approximately 1 per cent nitric acid, (2) temperature changes up to 100 deg. C. and (3) vibration due to heating by injecting steam.

A permanent installation was desired, which would require a minimum amount of maintenance and not be subject to accidental breakage and damage. In addition, the high purity of product required necessitated the use of materials of construction which would be unaffected by the above-mentioned conditions. After several trials on a small scale, the following type of apparatus was found to be the most suitable for carrying out this operation, and has proved very satisfactory. The 1,400-gal. tank installed is shown in Fig. 4, and consists of an outer wall of 6-in. reinforced concrete and a 4-in. lining of acid-proof brick and cement, and a 4-in. bottom of acid-proof brick and cement over 4 in. of concrete. A space of $\frac{1}{2}$ to $\frac{3}{4}$ in. is provided between the brick and concrete, and is filled with asphaltum. The lining of acid-proof brick was furnished and installed by Maurice A. Knight.

Factors considered in installing apparatus for agitating the contents of this tank were as follows: (1) Thorough agitation was required in order that the reaction of converting the particles of CaWO_4 into H_2WO_4 , both solids, be carried to completion. (2) The tungstic acid which forms settles out as a heavy paste, especially compact after long standing, and it was desired to prevent excess strain on the agitator when starting in motion. (3) Agitating equipment in the tank must be acid resistant.

These requirements were met by equipping the tank with a single-blade rubber-coated agitator operated by a Nett-Co type D-2 special drive and adjustable within a range of 18 in., the minimum height being $\frac{1}{2}$ in. from the bottom. The rubber coating was applied by the Goodyear company. A 2-in. by 10-in. wooden splash-board, adjustable with the agitator, extends down the side.

Because of the corrosive acid vapors from this operation, complete fume elimination was necessary and no exposed metal surfaces were permissible in the

reaction vessel. In order to carry the acid fumes out of the building, the tank is provided with a 3-in. wooden cover, which supports a 16-in. inside diameter wooden stack, 25 ft. high. Stoneware flues of special construction imbedded in the concrete walls of the tank aid in producing the draft. The calcium tungstate inlet consists of a flanged 3-in. pipe rubber-coated inside and out, as is also the case with the 2-in. water inlet. These pieces were coated by the American Hard Rubber Company.

A permanent installation was desired for the purpose of heating the strongly acid material in the tank, and several obstacles to such an arrangement presented themselves. The most suitable method of heating was by the injection of steam, and after trials with several materials, the following equipment was found to be the most satisfactory and was therefore installed:

A standard 2-in. pipe flanged at the top and rubber-coated inside and out by the American Hard Rubber Company, extends down through the cover to a point a few inches below the surface of the HCl solution in the tank. A flanged connection at the top is made to a 75-lb. steam line, and adjustment of the flow of steam made possible by means of a Merco-Nordstrom cock and a gate valve. Elimination of condensed water in the steam line is necessary and is effected by traps and heavy insulation.

It was desired to permit the suspension of washed tungstic acid to flow out of the tank by gravity into the dissolving tank containing ammonia. It was also necessary to have some means of preventing the heavy tungstic-acid paste from packing in the outlet during the reaction and during the washing, otherwise the outlet might become stopped up. A third requirement was that means be provided for transferring the tungstic-acid slurry from the outlet onto wooden filters situated nearby, in case it is desired to prepare the crude tungstic acid in a dry state. The tank is provided with a 2-in. stoneware outlet, to which is attached a three-way Knight stoneware valve. The acid-proof stoneware outlet is of special design and the inside diameter tapers down to 2 in. A hard-rubber plug is fitted into the flared end of the outlet thus formed. It is necessary, of course, that this plug be operated from outside the tank and in order to do this the plug is attached to a lever upon the cover by means of a rubber-covered pipe extending up through the tank. This plug arrangement has worked so well that when closed there is no leakage through the outlet when the tank is filled, even when the stoneware valve is open.

The next problem was the removal of the acid supernatant liquors and wash waters from the tank. As it was not desired to weaken the acid-proof brick lining by additional openings, no side outlets were provided for decanting the liquids. It was, therefore, necessary to devise some convenient means of drawing off the water rapidly from the top of the tank. The siphon arrangement shown in Fig. 5 was installed to fulfill this need. A 2-in. Duriron pipe extends from outside the tank near the top to the drain and contains a valve on the main floor level, 20 ft. below the top of the tank. To one branch of a tee at the top is attached the flexible siphon arm as shown, composed of 2-in. rubber hose and a glass cell for observation. To the vertical branch of the tee is connected a water inlet with a 3-in. glass chamber which serves to indicate when the siphon has been sufficiently filled with water. This apparatus works efficiently and requires a minimum of labor.

Some method of elevating the hydrochloric acid and conveying it to the tank was essential, and it was decided to accomplish this by means of compressed air, using acid-proof stoneware equipment. The installation as shown in Fig. 4 consists of an 80-gal. blowcase, an acid-receiving sink and conically flanged pipes and valves, all manufactured by the Maurice A. Knight company. The acid pit is constructed of concrete and painted with asphaltum. The blowcase is provided with a 1½-in. acid inlet from the sink, a 1-in. acid outlet connected to a 1-in. line to the purification process, and a 1-in. air inlet with standard three-way valve connected to a compressed air

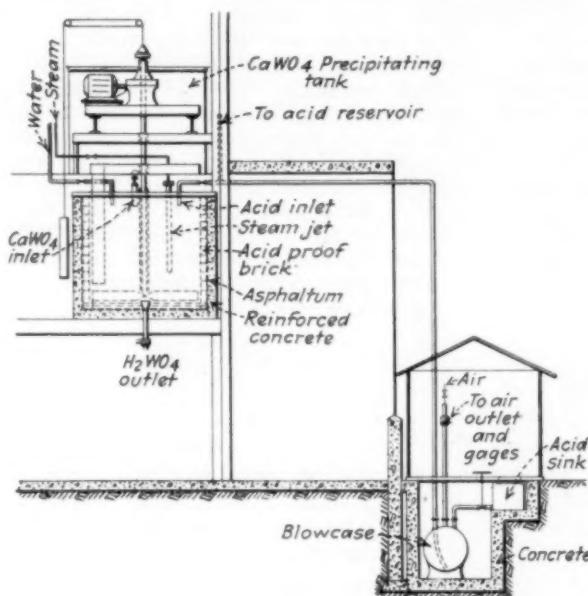


Fig. 4—Crude Tungstic-Acid Tank Showing Agitating and Acid Elevating Equipment and Calcium Tungstate, Steam and Water Inlets

line. The air inlet is provided with a pressure gage and safety valve. In order to make doubly sure of safety in operation, there is included a combined pressure gage and blow-off valve consisting of an open-arm mercury manometer. The acid receiving sink is of 50-gal. capacity and is filled two-thirds full of fine tungsten wire which acts as a strainer for solid material. A 1½-in. side outlet at the bottom drains into the blowcase. A lubricated stoneware valve on this line is equipped with an extension handle which can be operated above the cover of the pit.

In carrying out this step of the process, the required amount of HCl is elevated to the tungstic-acid tank and water added to give approximately 20 per cent HCl. The agitator is then started in motion, and the acid solution brought up to the specified temperature by passing in steam through the rubber-coated steam jet. The calcium tungstate from the preceding operation, suspended in water and thoroughly agitated is then dropped into the heated HCl solution. While this slurry is being added, a carboy of nitric acid is also added from the blowcase. The temperature is maintained and agitation is continued until decomposition is complete, after which the tungstic acid is allowed to settle. The supernatant liquid is then siphoned off, and the tungstic acid washed by decantation until free of soluble impurities.

The preparation of ammonium-tungstate solution comprises solution of the tungstic acid in ammonia, clarification, and the transportation of the solution. It was not desired to have the solution come in contact with any material which would contaminate the

product, and the necessary equipment was decided upon with this end in view. The equipment installed to carry out this procedure is shown in Fig. 6.

For dissolving the tungstic acid in ammonia, a 1,000-gal. cypress tank was set up underneath the tungstic-acid tank. This is equipped with a 2-bladed wooden agitator operated by a Nett-Co drive. Fumes are removed by means of a wooden stack 12 in. by 16 in. resting on the cover of the tank. Some means of elevating the ammonium hydroxide from the floor level and conveying it to the dissolving tank was desired. For this purpose an apparatus was designed to permit the ammonium hydroxide to be forced directly from the drum into the tank by means of compressed air, and to empty the drums completely. It consists of a 1½-in. pipe extending to the bottom of the drum through a 2-in. tee and a 2-in. bushing with tapered thread, which is screwed into the opening in the top of the drum. The top of the pipe is provided with a union for hose connection to the hard rubber pipe entering the dissolving tank. A ½-in. air inlet enters the 2-in. tee and is provided with a union for hose connection to the air line. A pressure gage and safety valve set to blow off at 10-lb. pressure are connected to the air line at this point.

Partial clarification of the solution is accomplished in the 700-gal. wooden settling tank on the highest level. Side outlets on this tank provide for decantation of the clear solution. Some consideration was given to the choice of materials for the pump and for the pipe line to elevate the turbid ammonium-tungstate solution to the settling tank. Hard rubber equipment was decided upon, in view of the quality desired in the finished product. The solution is transported through a 1½-in. hard rubber line by means of a hard-rubber vertical centrifugal pump, manufactured by the American Hard Rubber Company. The pump is driven directly by a 1-hp. motor, with arrangement made for a variation in speed up to 3,400 r.p.m.

Clarification is completed by filtering through wooden presses. These are of 3-in. cypress, 6 ft. long by 3 ft. 6 in. wide by 3 ft. 6 in. deep. The filter plate is placed 19 in. from the top. After investigation it was found that for solutions this type of filter gave very satisfactory results when set up in the following manner: A layer of Berkeley cambric is laid on the filter plate. This is followed by a continuous layer of heavy filter paper, folded to extend up the sides of the filtering space. Over this is placed another layer of cambric. A lining made to fit the entire filtering space, composed of Shriver filter cloth No. 1059 is then adjusted and a third layer of cambric laid over the bottom. The lining and filtering media are held in position by tightly fitting ¼-in. square wooden strips at the bottom along the ends and sides and across the center.

It is sometimes necessary to assist the filtration of the turbid portion of the solution by applying reduced pressure. For this purpose it was necessary to have a vacuum chamber, which would act as a receptacle for

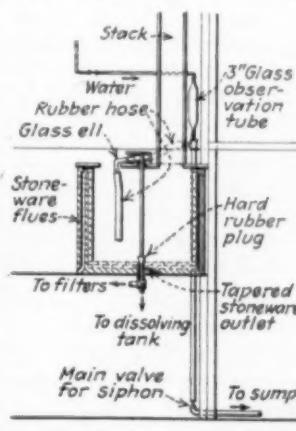


Fig. 5—Crude Tungstic-Acid Tank Showing Ventilating System, Tungstic-Acid Outlet, and Siphon for Removing Wash Waters

the filtered solution and which could also be used as a blowcase to elevate the solution. This must not only be capable of withstanding high vacuum and high pressure, but also possess a surface inert to the solution. To fulfill these requirements an 80-gal. rubber-lined steel blowcase was installed, in which reduced pressure is maintained by means of an Ingersoll-Rand vacuum pump. The blowcase is composed of a $\frac{1}{2}$ -in. steel shell, a $\frac{3}{8}$ -in. convex bottom and a $\frac{3}{4}$ -in. cold-rolled steel flanged cover. The rubber lining was applied by the American Hard Rubber Company. The blowtube consists of 2-in. flanged steel tubing rubber coated inside and out. In addition to the solution inlet, the blowcase has a third opening with connection to vacuum, water and air lines. The latter is equipped with an open arm mercury manometer which acts both as gage and safety valve.

All pipe lines used for conveying the ammonium tungstate solution, both before and after filtering, are com-

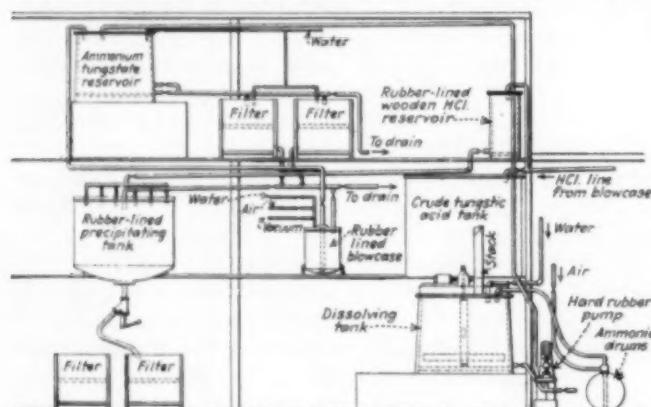


Fig. 6—Equipment for the Preparation of Ammonium-Tungstate Solution and the Precipitation of Ammonium Para-Tungstate

posed of hard rubber. The following procedure is used in carrying out this step of the process:

The required quantity of ammonium hydroxide is elevated to the dissolving tank. After the last wash water has been decanted from the tungstic acid as described in the preceding operation, a definite volume of water and tungstic acid remains in the tank. This is agitated thoroughly and then run by gravity into the ammonium hydroxide in the dissolving tank. The contents of the dissolving tank are agitated vigorously during the time the slurry is being run in and agitation is continued until all of the tungstic acid is in solution. The solution is then diluted to the specified volume and pumped to the ammonium tungstate reservoir on the highest level. Here it is allowed to settle, and the clear solution decanted onto the wooden filters in the manner indicated. The solution is allowed to filter through by gravity and to run directly through a 2-in. hard-rubber pipe line into the precipitating tank. The small amount of insoluble residue which has settled out in the ammonium tungstate reservoir is then rinsed onto the filters. Suction filtration is used for this portion of the solution. After determining that the solution has filtered clear it is forced to the precipitating tank and combined with the main body of the solution. The entire volume of ammonium tungstate is then diluted to the required specific gravity.

It was desired to install a tank for the precipitation of ammonium para-tungstate which could also be utilized for the precipitation of purified tungstic acid. Thus the tank must present a surface inert to ammonia, ammonium chloride and hydrochloric acid, capable of being easily cleaned, and in addition fulfill the qualifications required of the crude tungstic acid tank, as described in a preceding paragraph. Rubber-lined equipment appeared to be the most suitable material for withstanding these conditions. It was also necessary that provision be made for

thorough agitation, complete elimination of fumes, and for washing the precipitated salt by decantation. Apparatus was installed as follows:

The precipitating tank is of 1,400-gal. capacity and is made with a $\frac{1}{2}$ -in. steel shell with a $\frac{3}{8}$ -in. convex bottom. Agitation is provided by means of a single blade agitator formed to fit the convex bottom, mounted on a shaft of 3-in. wrought iron pipe, and with an 8-in. channel iron as a splashboard. Two $2\frac{1}{2}$ -in. flanged openings are situated on the side of the tank 16 in. and 22 in. respectively above the bottom, and at the bottom there is a 6-in. flanged opening. The cover to the tank is provided with openings for solution, water and steam inlets, acid jets, agitator, fume stack, and manhole. The tank and cover were made by the Berkeley Perforated Metal Company. A rubber coating $\frac{1}{8}$ to $\frac{1}{4}$ in. thick is provided over the entire inside surface of the tank and cover and extends through and over the outside surface of all openings. The agitator and splashboard are also rubber coated. Provision is made for heating the contents of the tank by means of a rubber-coated steam jet. Fumes are carried off by means of a 20-in. wooden stack which rests upon a rubber coated thimble. The vent apron extending down the outside walls of the tank aids in maintaining a draft up the stack. Decantation of the supernatant liquid and wash waters is carried out by means of 2-in. Knight-ware valves at the two side outlets. These open into a Duriron sink which drains to the sump.

IN NEUTRALIZING the ammonium-tungstate solution with HCl it is essential that excess of acid be prevented at the point of contact with the solution. It is necessary, therefore, that the solution be thoroughly agitated and that the acid be added in a fine stream. It is also necessary that a steady flow of acid be provided. From the blowcase, this acid is elevated to the HCl reservoir which consists of a soft-rubber-lined 100-gal. wooden tank, made by the Hauser Standard Tank Company. This tank is provided with a stoneware acid inlet through the cover, and a $1\frac{1}{2}$ -in. outlet from the bottom leading to the hard-rubber pipe line to the precipitating tank. At the precipitating tank the acid runs into a hard-rubber manifold, which distributes acid to six glass tubes which are inserted into holes in the top of the tank. Each glass tube is filled with glass wool to strain out foreign material and has four 0.060 in. orifices. Thus the acid is run in by means of 24 jets.

The bottom outlet of the precipitating tank presents some unusual features. As was the case with the crude tungstic acid tank, it was desired to allow the precipitate, suspended in water to flow out of the tank by gravity, but at the same time it was necessary to prevent stoppage of the outlet due to accumulation and packing of the material during precipitation. It was decided to use a rubber plug for the latter purpose. Since it was necessary to place the outlet in the center of the tank, however, it was not possible to manipulate the plug from above. An arrangement was therefore installed as shown, to work the plug from underneath. This apparatus consists of a flanged $2\frac{1}{2}$ in. (inside diameter) cast-iron fitting flared to $4\frac{1}{4}$ in. at the top and rubber coated on the inside. The flared end is attached to the bottom outlet of the tank and to the other end is connected a standard $2\frac{1}{2}$ -in. cast-iron flanged Y, rubber coated on the inside. A hard-rubber plug ground to fit the flared fitting at the outlet is connected to a $\frac{1}{2}$ -in. rubber-coated iron rod, which extends down through packing at the end of one branch of the Y to a lever. The other branch of the Y is connected to a flexible rubber hose which conveys the ammonium para-tungstate to the filters.

The wooden filters used are of the same type as the ones used for the filtration of the ammonium-tungstate

solution. On account of the extremely small particle size of the crystals, suction filtration is necessary, and provision is made for this operation. Final drying of the ammonium para-tungstate is carried out in a steam-heated Gordon drier. To insure cleanliness in this operation, the material is placed in Pyrex trays, 18 in. by 12 in. by 3 in. deep.

In carrying out the precipitation, concentrated high purity hydrochloric acid is elevated to the reservoir from the acid pit. With the ammonium-tungstate solution in the precipitating tank in agitation, the HCl is then allowed to run into the solution through the twenty-four 0.060-in. jets. The addition of acid is continued until the solution is just neutral. The very minute white needles of ammonium para-tungstate which are precipitated are allowed to settle and then washed thoroughly by decantation. After the last wash water has been removed, the precipitate is made up into a slurry by agitating with a sufficient amount of water. This slurry is then allowed to run into the filters where the crystals are drained free of excess water. The heavy paste is then placed in the glass trays and dried at 105 deg. C.

In the conversion of ammonium para-tungstate to tungstic oxide, contamination of the product is prevented by placing the dried ammonium para-tungstate in fused silica trays, and carrying out the ignition in Nichrome muffles. The trays are 12½ in. by 6 in. by 1½ in. deep and the muffles are 7 in. by 3½ in. by 4 ft. 6 in. long. These are open to the air at both ends and are heated by a gas-fired furnace. The furnace is maintained at 550 to 600 deg. C., and the trays of ammonium para-tungstate are pushed through continuously at such a rate that complete conversion to tungstic oxide is obtained.

Purity Obtained.—An example of the composition of the ore used as raw material in this process is as follows:

| Composition of Wolframite Ore | | | |
|--------------------------------|----------|----------|-------|
| | Per Cent | Per Cent | |
| WO ₃ | 71.16 | As | 0.07 |
| Mn | 7.29 | P | Trace |
| Fe | 11.72 | Mo | Trace |
| SiO ₂ | 1.49 | Sn | 0.29 |
| Al ₂ O ₃ | 0.52 | S | 0.14 |

The purity of the crude tungstic acid as obtained before dissolving in ammonia is measured by determining the percentage of total impurities which are non-volatile when sulphur monochloride is passed over the heated sample. Non-volatile impurities include SiO₂, Al₂O₃, CaO, MgO, KCl, NaCl, etc. A typical sample of the crude tungstic acid as produced gives the following results: Total non-volatile in S₂Cl₂ = 0.16 per cent.

An idea of the extent of the purification accomplished by the precipitated ammonium para-tungstate process in the installation described in this article may be obtained from the following typical analyses of the finished product, tungstic oxide.

Typical Analyses of Purified Tungstic Oxide

| | Lot No. 1 Per Cent | Lot No. 2 Per Cent |
|--------------------------------------|-----------------------|-----------------------|
| WO ₃ | 99.982 | 99.990 |
| SiO ₂ | 0.002 | 0.003 |
| CaO | 0.004 | 0.000 |
| Fe | 0.001 | 0.001 |
| Na ₂ O + K ₂ O | 0.007 | 0.004 |
| Mo | Trace | Trace |

It will be seen that practically complete elimination of the impurities is obtained. The few thousandths of a per cent of SiO₂, CaO, Fe and the alkalis remaining are decreased still further by the subsequent heat treatment applied to the pressed metal powder, which is carried out at a temperature above the volatilization points of the impurities mentioned.

Looking Into the Future of Byproduct Ammonia

By C. J. Ramsburg

Vice-President, The Koppers Company, Pittsburgh, Pa.

THERE have been three distinct periods of industrial development: mechanical, electrical and chemical. I think that it is fair to say that we entered the period of significant chemical development during the World War and that since that time the influence of chemical engineering and chemical research has been greater than that of any other branch of technical knowledge.

When the human race has its back against the wall fighting for existence and continuance, development is quickest and surest. For this reason, the chemical devel-

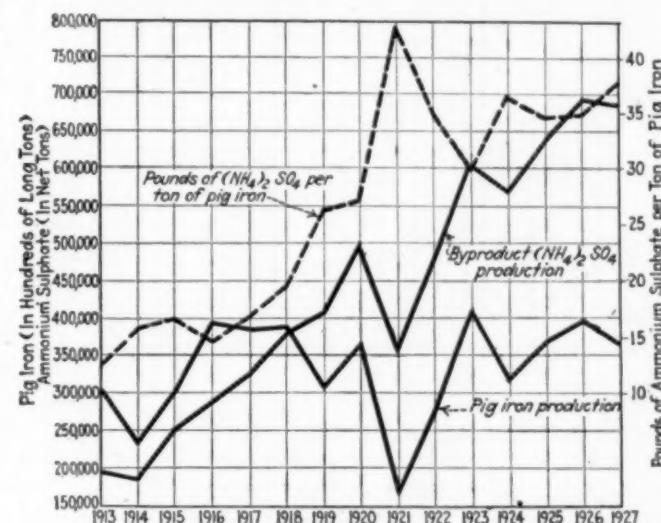


Fig. 1—Comparison of Byproduct Ammonia and Pig Iron Production Showing Increasing Ratio per Ton of Pig Iron

opment in the fixation of atmospheric nitrogen made rapid and enormous strides during the World War. For the same reason, the byproduct coking industry made such remarkable progress during the same period, particularly in America.

I have been asked to present the outlook for byproduct ammonia as it appears today. The point which I am going to try to bring forward is that the increase in the consumption of nitrogen in agriculture and in industry is such that we can no longer depend on byproduct ammonia to maintain the proportion of the market which it has been holding in the past ten years. The reason is not far to seek.

Fig. 1 illustrates what has been going on in the coking industry in connection with the iron industry. Today there is three times as much sulphate of ammonia produced per ton of pig iron as was produced in 1913. In 1913, practically 73 per cent of the pig iron produced was

Table I—Byproduct Coke Ovens—Built or Contracted for as of June, 1928

| | No. of Ovens | Annual Coal Capacity, Net Tons | Annual Ammonium Sulphate Production, Net Tons |
|--------------------|--------------|--------------------------------|---|
| Prior to 1926 | 11,660 | 49,061,339* | 633,649* |
| 1926 | 617 | 5,198,150 | 57,200 |
| 1927 | 384 | 3,127,323 | 34,390 |
| 1928 | 905 | 8,824,560 | 97,100 |
| Total Jan. 1, 1929 | 13,566 | 66,211,372 | 822,339 |

*Actual production for 1925.

Extracts from an address given June 14, at the Fourth Annual Convention of the National Fertilizer Association, Old Point Comfort, Virginia, June 11-14, 1928.

made from beehive coke, with no ammonium sulphate production. In 1927, only about 10 per cent of the pig iron was produced from beehive coke. In 1925, there were in the United States and Canada approximately 11,700 byproduct coke ovens. Since that time, there have been built, put in operation, or contracted for 13,566 ovens. Table I and Fig. 2 are summations of the

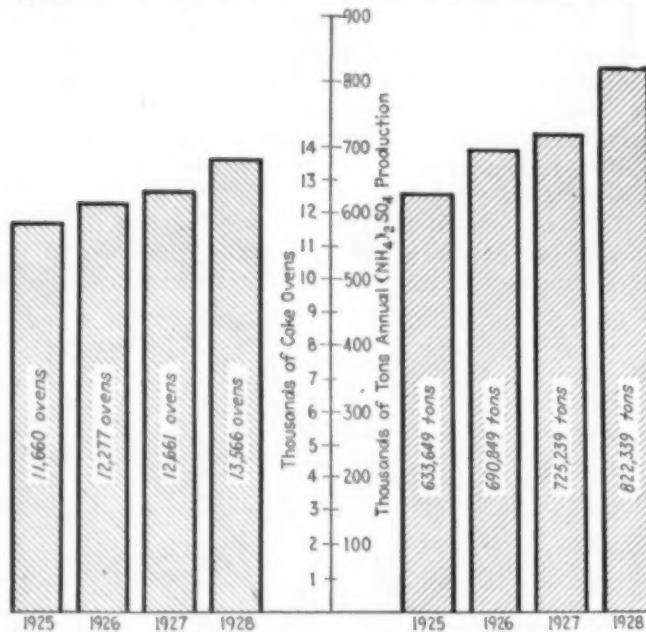


Fig. 2—Four Years of Progress in Byproduct Coke Production

ovens in operation prior to 1926, together with those built or contracted for up to January 1, 1929.

As shown in Fig. 3, the byproduct ammonia production of 1928 is estimated at four times that of 1913. In the six-year period, 1913-1919, the production doubles, and again will have doubled in the ten-year period, 1919-1928. And now comes the important fact. This rapid rate of increase in byproduct ammonia production, which has been witnessed during the past 15 years, is not likely to continue.

BYPRODUCT coke has replaced all but 15 per cent of the coke produced in the United States, rising from 27.5 per cent in 1913 to 86.2 per cent in 1927. By 1929, this figure will probably be at least 90 per cent, but the 10 per cent of beehive coke remaining will decrease but slowly. The iron industry is now practically saturated as regards coke products, and new ovens for this industry will be built only in proportion to the secular increase in iron requirements. Byproduct coke plants will be built for city gas and for domestic fuel supply, but such plants, even though many in number, cannot be a large factor in increasing the production of byproduct ammonia. At present a large number of cities in the United States receive a substantial part of their gas from coke ovens. About 20 per cent of the gas distributed by manufactured gas companies now comes from coke ovens.

The gas industry is a unit in the belief that in the future the base load gas for practically all locations will be coke oven gas or coal retort gas and for this reason

there will probably be a large number of small and some large plants built in the future. But so far as ammonium sulphate from such plants is concerned, the production cannot be a great factor, compared to the amount already being produced. For example: A plant is now being built in Philadelphia which will produce approximately 35 per cent of the entire gas requirements of that city. The production of sulphate in this plant will amount to but 7,000 to 8,000 tons per annum. This is a large gas plant, but its output of ammonium sulphate will be less than 0.9 per cent of the estimated production of byproduct sulphate for 1928.

THIS brings me to the thought at the beginning of this paper, namely, that this is a chemical age. Already the chemist and the engineer, spurred by economic necessity, have developed methods for the fixation of atmospheric nitrogen, which have attained great commercial success. As shown in Table II synthetic ammonia is now a large factor of growing importance in the world's nitrogen production. In 1926-27, synthetic ammonia furnished 56 per cent of the world supply of nitrogen and on an equivalent basis, was over five times the byproduct ammonia production in the United States.

In the United States, the picture is somewhat different. In the fertilizer year 1926-27, the distribution of nitrogen for the United States was about as follows: Byproduct ammonia furnished 47.5 per cent of the total for the country and synthetic nitrogen only 6 per cent. In this period, there was produced in the United States 37.6 per cent of the world's production of byproduct ammonia and only 2.4 per cent of the world's production of synthetic ammonia.

The synthetic production of nitrogen, in the United States and the world will increase to meet the inevitable increase in demand for nitrogen, which will occur at a rate beyond the power of the byproduct coking industry to satisfy. Byproduct ammonia will continue to be produced in slowly increasing quantities. Incidentally, the growth of synthetic nitrogen production will cause a slight increase in byproduct ammonia, due to the demand for coke to supply hydrogen gas for the synthesis. This amount, however, will be insignificant in comparison with the synthetic nitrogen resulting.

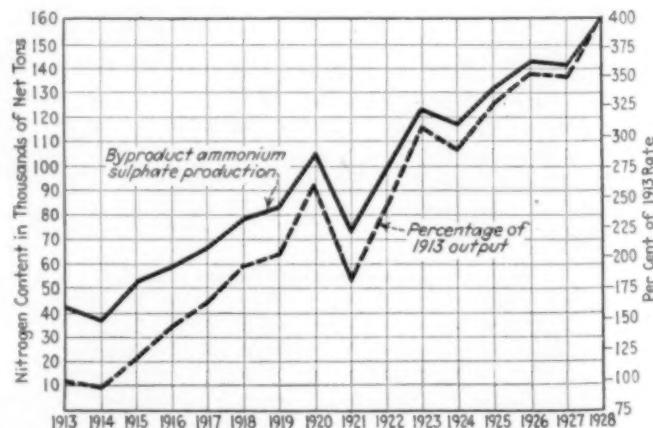


Fig. 3—Byproduct Ammonium Sulphate Production, 1913 to 1928

Table II—World Production of Nitrogen

| Year ending May 31st | 1923-4 | | 1924-5 | | 1925-6 | | 1926-7 | |
|--|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
|  | Net Tons | Per Cent | Net Tons | Per Cent | Net Tons | Per Cent | Net Tons | Per Cent |
| Byproduct ammonia from coal—sulphate equivalent..... | 1,682,000 | 29.8 | 1,738,200 | 28.2 | 1,837,000 | 25.8 | 1,830,000 | 27.7 |
| Chilean nitrate—ammonium sulphate equivalent..... | 2,157,800 | 32.0 | 1,960,000 | 31.8 | 2,129,000 | 29.9 | 1,064,000 | 16.1 |
| All synthetic nitrogen—ammonium sulphate equivalent..... | 1,807,000 | 38.2 | 2,465,500 | 40.0 | 3,155,000 | 44.3 | 3,714,000 | 56.2 |
| Total nitrogen—ammonium sulphate equivalent..... | 5,646,800 | 100.0 | 6,163,700 | 100.0 | 7,121,000 | 100.0 | 6,608,000 | 100.0 |
| U. S. byproduct ammonia from coal, per cent of world production of nitrogen..... | 10.7 | | 9.2 | | 8.9 | | 10.4 | |

How Electricity Produces C. P. Acids

Chemically pure hydrochloric and nitric acids
are made at less cost by electrical distillation

By C. M. Hoff

Grasselli Chemical Company, Cleveland, Ohio

A BETTER METHOD for the manufacture of chemically pure hydrochloric acid was desired. Efforts were directed toward developing a continuous process, employing first fuel heating and later electrical energy for distillation. The paramount difficulty lay in obtaining suitable materials of construction.

It was expedient in this case to produce the chemically pure hydrochloric acid, using the commercial product as a source of supply. The chemically pure acid was specified as a solution of 22.75 to 23.5 deg. Bé., containing 37 to 38.5 per cent of HCl. Commercial acid of about 22 deg. Bé., was used. Hydrogen chloride gives a constant boiling point solution of 20.24 per cent at 110 deg. C. If stronger acid be boiled, HCl gas is evolved until this solution concentration is reached, while a weaker acid, if heated, will boil off weak acid until a 110 deg. C. boiling point is attained, when the constant boiling mixture will distill. This property requires that a purification process depending upon distillation make provision for the absorption of the gaseous HCl evolved, in the constant boiling mixture which distills if a product stronger than this be required. Formerly, the process was carried out using glass equipment comprising a series of units each consisting of a distilling flask, condenser and a number of receivers. As the receiver temperature increased due to condensation and absorption of the gas, it was necessary to make three receiver changes during a run. The method resulted in high cost for labor and breakage, low capacity and poor working conditions. This process of producing a chemically pure acid was obviously open to many objections. It appeared that if the distillation could be carried out continuously, that not only would the labor be reduced, but the breakage as well, and that it would be simpler to maintain purity.

The early experiments consisted in running acid through a gas heated tube, at such a rate that a small amount of acid would run through as a liquid while the remainder distilled, some as HCl gas and some as constant boiling point solution. The undistilled residual portion retained the impurities and was run into a closed vessel, while the gases passed into a condenser where it was found that the constant boiling point solution could be condensed and the gas absorbed therein in a continuous manner. By decreasing or increasing the crude supply, a weaker or stronger product was produced, and at the same time, the proportion of waste acid to constant boiling point was lowered or increased.

The next step consisted in using electric heating with the acid itself serving as the resistor. This was carried out in a 10-gal. earthenware blowcase using graphite

electrodes connected to an alternating current source. Some electrolysis, however, occurred. Inasmuch as there had been no dissociation in a previous experiment with electrical heating, it was assumed and later confirmed that the electrolysis of the acid was due to too high current density. Electrolysis might have been prevented by the use of higher frequency current but it was desired to employ the commercial frequencies used in the plants. Hence a tile and cement retort was substituted in which provisions were made for larger electrodes so that the current densities thereon would be lower. Also, in order to increase the resistance of acid in the retort, an insulating bridge was constructed between the electrodes. An overflow, the height of which could be regulated, controlled the acid level and provided for the removal of the waste residual acid containing the impurities. A day's operation of the improvised retort demonstrated that this design would eliminate the previous troubles so that an earthenware retort was duly procured. However, despite careful use, it cracked, indicating that earthenware vessels of this type would not stand the thermal strain.

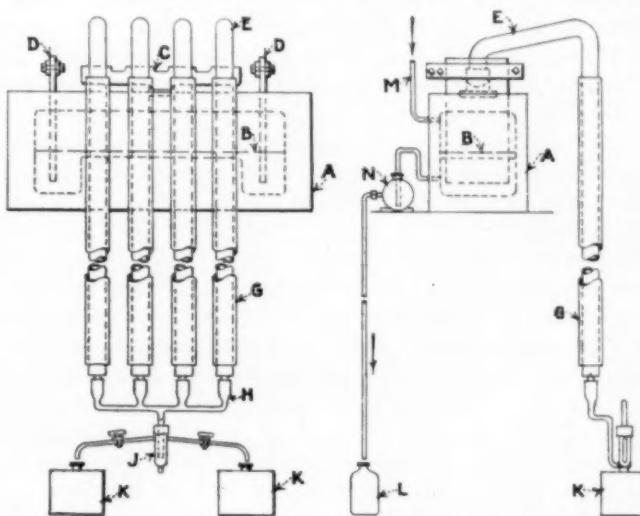


Fig. 1—Two Vertical Views of the Equipment for the Production of Chemically Pure HCl by Electrical Distillation

A, granite retort; B, acid level; C, earthenware manifold; D, graphitized electrode; E, Pyrex condenser tube; G, water jacket; H, Pyrex manifold; J, hydrometer boot; K, carboy; L, residual acid receiver; M, crude acid inlet; N, acid level control.

After a number of unsatisfactory attempts with various materials, a retort cut from a block of granite was tried and found to resist successfully the chemical action, the thermal strain and to act satisfactorily as an insulator.

The apparatus, as finally assembled is shown in Fig. 1. It consisted essentially of a granite retort provided with openings for electrodes, an inlet for crude acid and out-

Taken from a paper presented by the author at the Bridgport meeting of the American Electrochemical Society on April 27, 1928. Attention is called to the fact that U. S. Patents Nos. 1,546,961, 1,628,529 and 1,597,120 have been issued covering various phases of the process and equipment.

lets for waste acid and the products of distillation. The latter outlet was connected to the Pyrex glass condensers by means of an earthenware manifold with four luted outlets. Four condensers were used, each 3 in. in diameter and 10 ft. long, bent at the top so that any acid condensing immediately upon leaving the manifold would reflux. The condensers were water-jacketed and provided with a collecting manifold of Pyrex glass.

The condensers used in earlier experiments had been packed full of pieces of small glass tubing, with a seal of about $\frac{1}{4}$ in. of acid in the lower end of the condensers so that any HCl gas would not escape unabsorbed. Each condenser under these conditions had a capacity of 25 lb. of acid per hour, but it was later found that by removing the seal and all but 6 in. of packing in the lower end of the condenser that the capacity was nearly doubled. Operation of the condenser was also smoother as no back pressure was created. At first, the iron content of the purified acid was dangerously near the specified limit and was higher at greater capacities. This indicated that iron salts were being mechanically carried over into the condensers, and it was found that by placing 6 or 8 in. of loosely packed glass wool in the end of the condensers adjoining the retort, that the amount of iron was reduced to almost one-tenth the previous amount.

Due to the fragility of the glass condensers, a rigid connection to the retort manifold was prohibited. Lutes were therefore used and sealed with phosphoric acid which was selected after trying numerous materials in an effort to secure something that would not affect the acid or be itself affected.

The retort, as it was made of granite, was necessarily made in two pieces with the joint as high as possible above the level of the acid. Ordinary asbestos was unsatisfactory for calking this joint as it is somewhat soluble in hydrochloric acid. Blue Cape asbestos is almost insoluble, but did not make a tight joint until the procedure of thoroughly wetting it before and during calking was adopted. The same method was used in calking the electrodes and the earthenware manifold.

AS THE proper acidity was essential, provisions were made for continuously determining the specific gravity and the temperature of the acid leaving the condensers. The distillate from all four condensers was collected, and passed through the hydrometer boot or "gravity jar" shown at the bottom of Fig. 1. The strength of the product could be easily controlled. Having established a definite power consumption by setting the level of the acid in the retort, with the strength of crude acid held constant, the strength of the acid produced varied as the rate of flow of the crude acid into the retort and hence as the amount of overflow of residual acid. By the use of a sight glass, of the design shown in Fig. 2, the same rate of flow could easily be maintained and it was found necessary for the operator to adjust the feeds but once or twice per hour.

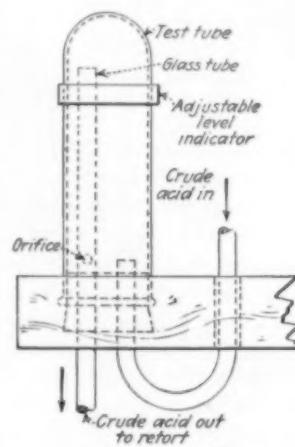


FIG. 2—Type of Sight Glass Used to Control the Rate of Crude Acid Feed to the Retort

The electrodes used consisted of graphitized carbon plates 30 in. x 6 in. x 1 in., two of which were placed in each end of the retort and firmly calked in position. Each electrode presented about 1 sq.ft. (one side) of surface to the acid, and was drilled with several small holes to insure easy circulation of the acid. No evidence of electrolysis has been found even with a current of 600 amp., and no disintegration of the electrode takes place.

During the experiments, which included the production of more than 200,000 lb. of chemically pure acid, a number of important facts were established. The granite retort, although not absolutely impervious to the acid, did not show any deterioration during the period of use, and satisfactorily maintained its electrical resistance and resistance to thermal strain. The capacity of the retort was not determined as this apparently could be increased by raising the level of the acid solution until it nearly reached the top of the retort. It was found desirable, however, to maintain the level of the acid below the calked joint of the retort, as there was a slight seepage if it were raised above this point. Capacities of over 200 lb. per hr. could be obtained without encountering this difficulty. This figure was quite close to that of the condensers, which was found to be about 180 lb. per hr. Their capacity varied, of course, with the temperature of the cooling water. The amount of cooling water required also varied with temperature as the table shows.

Cooling Water to Condense 125 lb. HCl per Hour

| Cooling Water | | Gal. per Hour | Acid Temp. Deg. F. |
|----------------------------|-----|---------------|--------------------|
| Temperature, Deg. F. In | Out | | |
| 42 | 72 | 517 | 50 |
| 60 | 68 | 2,025 | 60 |
| 60 | 72 | 1,163 | 62 |
| 70 | 82 | 1,213 | 80 |
| 85 | 103 | 848 | 85 |

The crude acid used should have a specific gravity of 21.5 to 22.5 deg. Bé. for best results. Stronger acid requires dilution, and weaker acid produces excessive quantities of waste acid. It is essential that at least one part of residual acid be produced for seven parts of chemically pure acid in order to prevent the concentration of impurities in the retort to such a point that they will tend to be carried into the condensers in undesirable quantities. The power required for distillation is quite low. One kw.-hr. produces as much chemically pure acid as did 7.6 lb. of coal by the old process.

Furthermore, the new equipment occupies less than one-half of the floor space needed for the old and has a capacity approximately twice the former. And while the working conditions in the old plant were bad, due to fumes and heat, the room in which the electrical process is operated is almost free from acid gases and is at normal room temperature, summer or winter. The labor required has been substantially reduced. One man at present equals the former production of seven.

In later adapting the process to nitric acid distillation, it was found that only one-half of the condenser capacity required for HCl was needed since the necessity for absorption is eliminated. However, means must be provided for the condensation and removal of the lower oxides of nitrogen which are given off during the distillation. Concerning materials of construction, it was found that a Duriron manifold is preferable to earthenware and that while graphite electrodes have an apparently limitless life with HCl, they become soft and disintegrate with nitric acid. Similarly, the granite retorts, while not attacked, have sometimes broken due to the higher temperatures used. Better materials for retorts and electrodes have been sought but have not yet been found.

Pressure Electrolysis of Water Eliminates Need for Compressors

By J. E. Noeggerath

Berlin, Germany

ELECTROLYTIC dissociation of water under pressure, which has been known since 1900, proceeds within enclosed vessels in such a way that the gases are continuously generated in spite of the confined space. A constantly increasing amount of gas must be accommodated by a practically unchanging volume: as a consequence the pressure continually rises. A recognition of this circumstance has meanwhile led to the expenditure of much time and ingenuity in an effort to generate oxygen and hydrogen by pressure-electrolysis, since inventors sensed an opportunity for saving compressors.

Just as in electrolysis under atmospheric pressure, one-third of the gas volume consists of oxygen and two-thirds of hydrogen. The quantities generated are proportional to the current; and as long as the pure gases are separated as produced, the quantity is practically independent of the nature of the apparatus. The principle difficulty, hitherto, has been the economic production of gases in a sufficiently pure state. Apart from the occasional formation of dangerous mixtures, there were constructional problems involving strength, durability and tightness to leaks, especially where caustic or acid was to be used at high temperatures and pressures. Insulation was also a factor, particularly for an arrangement of cells in series.

In experiments on a laboratory scale it was found that with low voltages the purity of gases could be rather easily maintained, as long as the apparatus was absolutely tight and the gases were kept in a strict 2:1 ratio. In practice, however, these conditions were difficult to maintain, because arrangement in series is necessary for normal voltages but difficult for pressure-electrolysis, due to leakage; furthermore an even removal on both sides is difficult and necessary too, in order to avoid changes in the volume ratio. At 200 atm., for example, a difference in pressure of only 5 per cent will result in a net pressure of 10 atm. on the fragile separating walls. In pressure-cells without these walls (where the arrangement of the electrodes effects the separation) the gas under higher pressure forces the electrolyte to the opposite part of the cell. Often, too, the heat and gas bubbles cause motion and mixture of the electrolytes and the entrained gases.

AN APPARATUS for the production of O_2 and H_2 under 150 atm. normally has been developed by the author, with the support of the faculty at the Technische Hochschule, Berlin, and officials of the German State Railroad. It is designed to meet the requirements of practice and, in view of its performance,

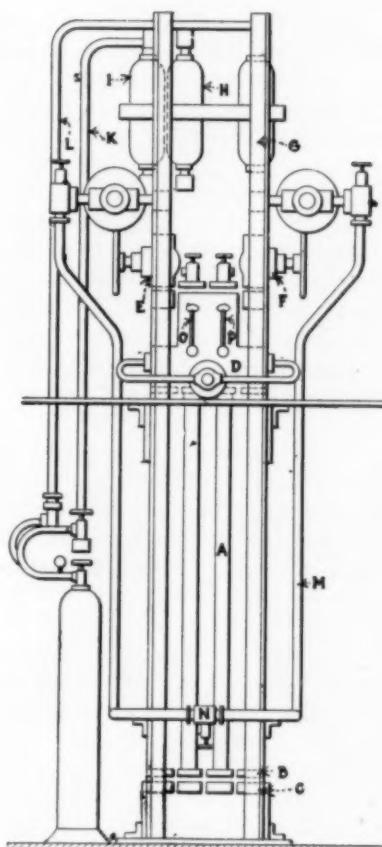


Fig. 1—Design of Electrolyzer Producing Gas at 150 Atm. Pressure

- | | |
|--------------------------------|----------------------------|
| A. Pressure cell. | H, I. Hydrogen holders. |
| B. Current entering electrode. | K, L. Tubes to cylinders. |
| C. Cover. | M. Compensating line. |
| D. Distributor. | N. Replacement water feed. |
| E, F. Valves to gas holders. | O, P. Check valves. |
| G. Oxygen holder. | |

has very small dimensions. The pressure of 180 atm. obtained in it does not represent the possible upper limit for this type, since this depends wholly upon problems of construction.

The design, which was thoroughly tested during the past year by the Technische Hochschule, Berlin, and the State Railroad, is reproduced in Fig. 1. The actual pressure cells are the tubes indicated by *A*, through the axis of which run the negative nickel electrodes generating the hydrogen. The latter are surrounded each by a concentric separating wall, and the walls in turn by concentric positive electrodes which generate the oxygen. The electrolyte is potassium hydroxide.

The current is supplied to the positive electrodes at *B* the vessel itself serving as conductor. It passes through the separating wall (not shown) to the negative electrode and leaves the cell again at its cover *C*. For operation at normal voltages the cells are arranged in series in a certain definite order. The arrangement is not indifferent,

since pressure cells, placed merely in series, might easily generate gaseous mixtures.

The oxygen rises up along the outer section of the pipe *A*, collects in the passages of the distributor *D*, then enters the holder *G* by valve *F* and finally flows to the cylinders through the pipe *L*.

Completely separated from the oxygen by the intervening wall, the hydrogen rises along the axis of *A*, collects in the other passages of the distributor *D*, and flows through the valve *E* to the holders *H* and *I* and through the pipe *K* to its cylinders.

The two electrolyte chambers are connected by a compensating line *M*, to which the replacement water for the electrolyte is fed at *N*. This compensating line has a large capacity, so that the electrolyte from one half will not run into the other when there is a difference in pressure. Its great length allows of such a small cross-section, however, that the velocity of the feed water for the electrolyte greatly surpasses that of the gases tending to enter the compensating line. This is the first application in pressure-cells of an elastic compensation which will react to the slightest variations in pressure. A special device is also present to bring the various elements back to a state of equilibrium.

The check-valves *O* and *P* serve to cut off the cells from the possible seat of disturbance, should there be any sudden unforeseen difficulties arising outside.

FIELDS of application of the pressure dissociator are rather varied, due to its flexible nature. Thus, in contrast with most installations having a reduced efficiency at underloads, the pressure cell has certain advantages when the load decreases. It is therefore very suitable for varying loads such as are incurred by the use of waste or off-peak current. Of far greater importance, however, are applications such as the following:

1. Production of hydrogen and oxygen in chemical plants. A special advantage here is the elimination of impurities in the gas, which often cause much difficulty in industry. Electrolytic hydrogen has already been used for some time in synthetic ammonia production in Italy, and more recently, in Germany and other countries. In the liquefaction of coal the hydrogen for the essential process can be very economically produced in a pressure electrolyzer. The oxygen can sometimes find application, too.

2. Storage of energy. Off-peak current can be used to generate hydrogen, which would be stored and, when necessary, used in hydrogen-motors in conjunction with dynamos. Great amounts of energy can be stored in this way, within a very small space. This type of storage, however, is only advisable where there are large variations in power consumption, since the total efficiency is not very high.

3. Hydrogen-locomotives. A further application of power storage is in hydrogen-locomotives, which are used on uneconomical branch lines of electric systems or where there is plentiful cheap power. The high cost of installation and the low utilization of electric branch lines have made them very uneconomical. The situation can at least be relieved by applying the electricity through the indirect agency of electrolytic hydrogen in Diesel locomotives. The weight of the filled cells is no greater than the coal and water of steam locomotives.

4. Long-distance supply of gas. Since the compression has been procured without any cost whatever, a pressure drop can be utilized to supply hydrogen over great distances, by feeding it at 200 atm. into pipes of very small

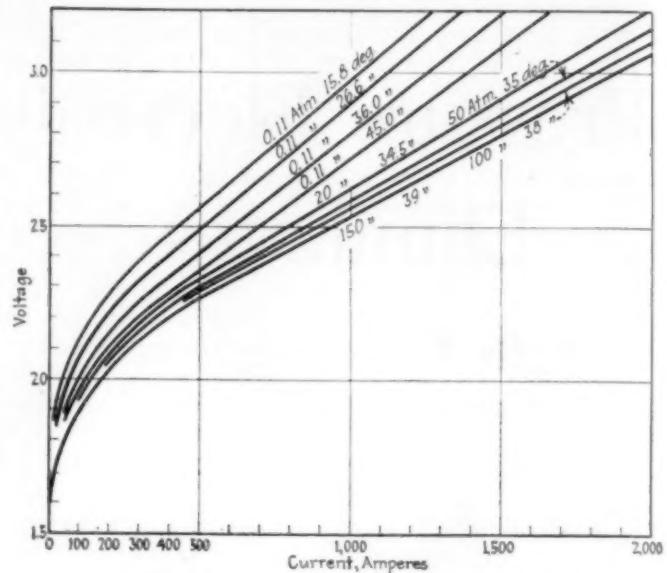


Fig. 2—Variation of Current with Voltage in a Cell at Different Pressures and Temperatures

cross-section. Likewise, hydrogen at 200 to 300 atm. can be used to compress other gases to 30 or 40 atm., thus saving large installations. The oxygen generated may be used in combustion or gasifying.

5. Increasing efficiency of combustion. Gasoline automobile engines, according to experiments by Hausmeister, have been run successfully with a small dissociator feeding an explosive mixture into the fuel in very small quantities. The tests of a German experimental institute showed that the consumption was decreased and the output increased, although the motor was loaded with the dissociator.

The products of the dissociator could likewise find convenient application in numerous other fields where these gases have been used. Such applications include the combustion of oil or coal-dust with the addition of both hydrogen and oxygen; the hydrogenation of fats for soap or edible products; and the electric arc-welding process in an atmosphere of hydrogen.

IN TESTS by the German State Railroad and the Technical School it was shown that this pressure-generator at present produces the gas at an expenditure of 3 to 3.5 kw.-hr. per cu.m. (20 deg. C. and 760 mm. of Hg).

The guaranteed purity of 98 per cent was considerably exceeded. Without catalytic purification the tests showed a purity of 99.1 per cent for oxygen and 99.9 per cent for hydrogen. Under special conditions the average purity ran even higher.

The use of the pressure-compensation already discussed resulted in perfect automatic equality of pressure, without the necessity for lever control or electrical relays; nor was the separating wall ever harmed by the pressure. That there is also a high degree of operating safety was shown by the fact that, when the cells were subjected to one-sided pressure rising up to 300 atm., the manometers on both sides indicated the increase simultaneously.

In operation, the cells are first subjected to a higher voltage than that necessary for decomposition. A current now begins to flow which increases with rising voltage, and the cylinders to be filled are connected. When the desired pressure of 150 or 200 atm. has been obtained the cylinders are removed and replaced by new ones, and the pressure drops again corresponding to the volume.

The relation of current and voltage in a cell, for different pressures and temperatures, is seen in Fig. 2. It is evident not only that the dissociation requires lower voltages at rising than at atmospheric pressure, but also that the pressure rise reduces the voltage more than the higher temperature alone would do it. The voltage-drop being a measure of the energy consumed, there is consequently a saving not only in compressors but also in the energy required as compared with ordinary dissociation.

THIS economy arises from several factors. In the first place, the minute gas bubbles formed at the electrodes have such an enormous surface tension that the 150 or 200 atm. pressure in the gas chambers becomes insignificant in comparison. Hence the difference in the energy necessary for producing the gas at normal and at the higher pressure is immeasurably slight. On the other hand it was found that the liberated gas-bubbles, which affect the electric path, are compressed as the pressure increases and, due to their reduced volume, lower the resistance and voltage of the electrolyte. Similarly the polarization due to the bubbles adhering to the electrodes is reduced as the pressure rises and the voltage is lowered here too.

In general these reductions of the electrode voltage in pressure electrolyzers so greatly outweigh the opposite factors that the total voltage decreases with a rising pressure. This is not an inevitable result: it is also possible to construct pressure cells in which the voltage will increase with rising pressure. Various other minor influences have not been touched upon here; but it should be remembered that the distance between electrodes and the temperature of the electrolyte must be taken into account in accurate determinations.

As a result of the comparative tests applied to pressure dissociators, the influence of the various factors in relation to the pressure could be summarized graphically as in Fig. 3. The assumed current of 1,500 amp. corresponds to the curve A.

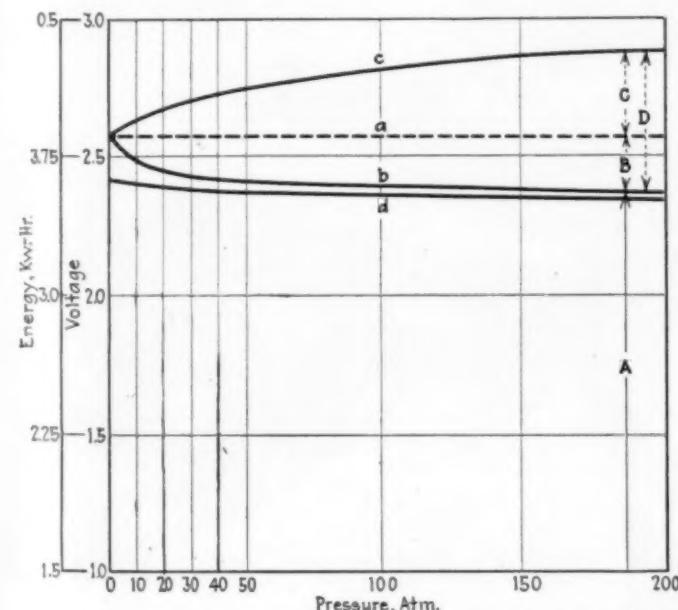


Fig. 3—General Effect of Pressure at a Current of 1,500 Amp.
 a. Consumption of energy at A. Total consumption of energy in pressure electrolysis.
 b. Consumption of energy in B. Gain in electric energy due to pressure electrolysis.
 c. Energy requirement at atm. C. Energy consumed in subsequent compression.
 d. Voltage due to resistance of D. Total gain in energy for electrolyte, disregarding pressure electrolysis compared with normal electrolysis and subsequent compression.
 gas bubbles.

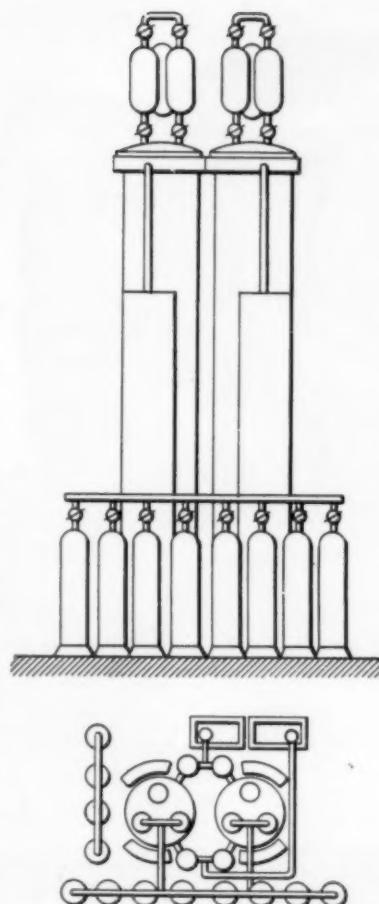


Fig. 4—Pressure Electrolyzer for Producing One Million Cu.M. of Gas per Year at 400 V.

sponds to the current necessary for generating one cu.m. of gas at normal temperature and 760 mm. of mercury. The relation of D to A shows that normal decomposition with subsequent compression requires about 25 per cent more energy than pressure electrolysis. The pressure dissociator has the following further practical advantages:

1. High efficiency: The consumption for large currents is from 3 to 3.5 kw.-hr. per cu.m. at 200 atm.

2. Small and inexpensive construction: They cost considerably less than normal electrolyzers and are often cheaper than even the compressors alone.

3. High purity of gases: According to experiments, 99.1 per cent for oxygen and 99.9 per cent for hydrogen.

4. Economy of space: Fig. 4 shows an arrangement for producing 120 cu.m. per hr., covering an area of only 2 sq.m. The design is the same as that intended for the State Railway. Particular emphasis is laid on simple construction and on the fact that the potential is the same as that of the ground, despite the series arrangement.

5. Cost of housing: This is very considerable for normal cells, whereas it can often be wholly eliminated in the case of pressure-cells, since it has been found that they can be used in the open air.

6. The cost of the compressors is eliminated.

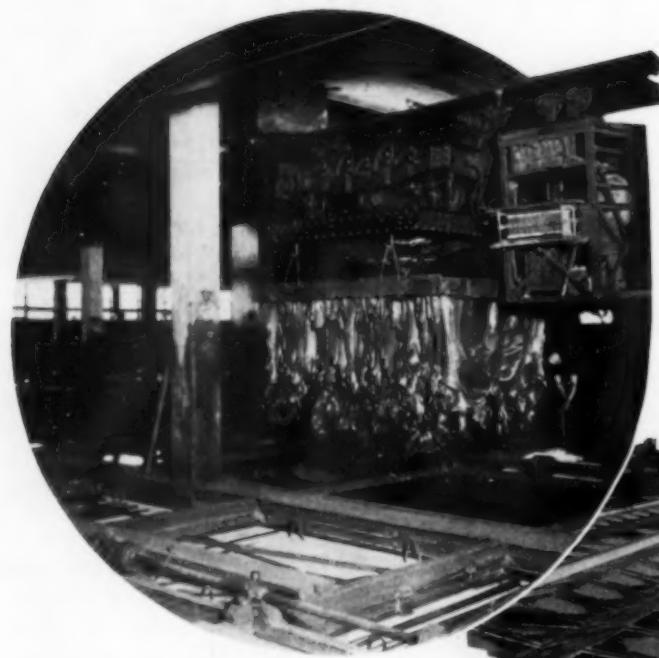
7. The expense of compression is removed.

8. The principal part of the labor cost, i.e., operating the compressors, is obviated.

9. Since the cells can be constructed for large or small quantities of gas, its production can be decentralized.

The danger arising from the mixture of oxygen and hydrogen due to the presence of catalysts, local heating and so on, is completely eliminated in the new pressure cells. The purity alone is so high, that even the presence of a catalyst would be without effect. On the other hand, even a highly compressed explosive mixture would not explode if no active catalyst were present. This is confirmed by the electrolytic experiments of Coehn and Jaenkel at 3,000 atm.

In conclusion it may be remarked that, while the present discussion is confined to the electrolysis of water, there is no reason why the principle of pressure-dissociation may not be applied to the production of other gases, as soon as experiments have yielded the necessary information on their behavior under working conditions.

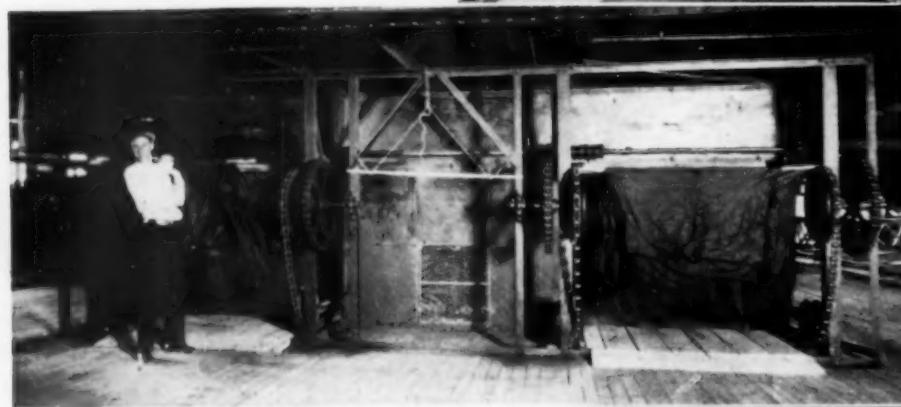


The rocker yard is above, with a rack of hides about to be lowered into one of the pits for vegetable tanning.

Some of the Old and Some of the New About the Tannery



Above—The sunning yard, until now the only recourse of the patent leather manufacturer. Patent leather lacquers require the action of actinic rays.



A modern tunnel drier for hides appears above. This has considerably reduced inventory and improved quality for certain kinds of leather.



Hides in "green salted" storage, above, are kept in a cool atmosphere. Note the overhead brine lines.



At the left, calf skins are being subjected to hot plating in heated presses in order to give highly polished surface to the leather.

LEATHER *Industry Challenges*

Chemical Engineering

PERHAPS leather making was the first art discovered by man. Certainly, the earliest peoples of whom we have record knew how to make and to use leather. It is a tribute to the skill of Egyptians—and of Romans too—that they made leather so well that specimens in a healthy condition are constantly being discovered.

But the leather industry, like all of our older industries in this country, is passing out of an era in which it could afford to accept the accumulated experience of the past as an infallible working basis for the future. Progress, as it is understood by the tanning industry today, calls for supplementing the older art with the findings of research in pure science, with the development of an even more effective technology.

Let no one believe that because relatively few chemical engineers are working in tanneries that the leather industry necessarily must be altogether backward in its methods. Every tannery performs at least 30 process operations to make leather, while some tanneries making such leathers as suede calf may perform 80. If one operation is out of line the leather is spoiled. Perhaps it is enough to say of the present-day tanner's skill that he spoils mighty little!

For the tanner today, however, simply making serviceable and attractive leather is not sufficient. There is no longer freedom from severe competition within the industry. Nor is there freedom from competition of synthetic materials offered as substitutes for leather. Nor is there a supply of raw material for leather that allows the tanner to make his purchases in a buyers' market. The world now has more leather consumers but not a correspondingly increased supply of hides and skins.

These factors have led to infiltration of scientific men into the industry. Whereas the chemist and bacteriologist were frowned upon a few years ago, today their activities are sponsored by liberal appropriations, both for co-operative industry research and for individual plant research and development. One modest concern spends more than \$70,000 a year for research workers' salaries—and that staff is headed by a chemical engineer!

THERE CAN BE no question that, in the leather industry, chemical engineers have an opportunity that is challenging. The individual, selling his services today, however, must first sell chemical engineering, because tanners, while sold on chemists, have not generally understood the scope of the chemical engineer's work as differentiated from that of the chemist.

The chemical engineer who recognizes his opportunity and has won the right to prove the value of his services should listen to John Arthur Wilson, whose success as a practical scientist permits him to say, "One of the greatest disappointments awaiting the chemist [this holds for chemical engineers too!] who attempts pioneering work in the tannery is to find that whatever change he institutes in a given operation results in lowering the quality of the finished leather. For a time he may regard the

By HAROLD J. PAYNE
*American Leather Producers, Inc.,
New York*

tanners who developed the process as supermen. But the explanation lies in the fact that the details of all of the many operations involved in tanning are so interrelated that any change in one operation upsets a balance and requires an adjustment in other operations, without which the leather will be spoiled."

WHATEVER the leather made, the raw material is complicated skin or hide substance. Its composition is likely to be approximately 60 per cent water and 40 per cent solids, comprising mainly the protein collagen together with smaller quantities of the proteins keratin, elastin, mucoid, albumin, and globulin. Mineral salts, sugars and fatty bodies complete the structure.

During life these components are maintained in a state of equilibrium. As soon as death takes place, degenerative changes occur. The carbohydrates break down into lactic acid (and possibly also other organic acids); the fatty bodies begin to change as fatty acids are split from their bases. The combination which exists between part of the skin fat and the skin protein begins to break down and the skin proteins themselves start to degenerate into simpler compounds. Most of these degenerative changes are the direct or indirect result of the action of bacteria with which the skin is covered when removed from the carcass. Hence, in order to understand and control the chemical changes noted, it is necessary to approach the problem bacteriologically.

At present, much of the organic and physical chemistry of skin proteins is unwritten. Much work has been done during the past decade to account for the swelling and the tanning of skin proteins. The value of this work undoubtedly is not yet fully recognized partly because the theories which it has indicated have usually failed to work out in practice. This failure is probably due to the fact that the greater part of the experimental work was performed with gelatin or similar colloids whose only relation to skin seems to be their common protein nature.

It is now realized that progress in the physical chemistry of skin proteins must await fuller knowledge of their structural chemistry—the groups which combine with acids or with bases—or tanning materials; how such groups are made reactive or are destroyed.

Organic tanning materials, applied primarily in the form of vegetable extracts, are little known as to their organic chemistry. Much study has yielded small return aside from the brilliant work of Fischer and Bergmann in their synthesis of gall nut tannin. The action of tannins on hide substance appears to be greatly affected by the degree of dispersion of the tannin, the temperature, and the pH value of the solution.

Inorganic tanning materials, such as chrome salt liquors, have now received extensive study as to their

physical chemistry with excellent results which have advanced our knowledge of their behavior with skins. Similarly, histological studies of skin structure have proved valuable both theoretically and practically.

Despite these scientific complexities, progress is being made in the application of scientific methods to tanning. The research laboratory of the Tanners' Council of America has been helpful in establishing the laws governing the curing and conservation of skin. Control has ousted rule-of-thumb in soaking. Enough is known of the chemistry of unhairing to effect a decided conservation of the leather-forming material—and to produce hair of maximum value as a byproduct. It should not be long before unhairing is thoroughly scientific.

IN BRINGING about improvements in processes, the engineer has had to apply in the tannery methods and equipment to take advantage of laboratory discoveries. It has been his prerogative to question earlier materials of construction and methods of handling stock, as well as the value of certain operations or series of operations. Two immediate evidences of his work are found: first in the use of pits of concrete instead of wood for soaking and liming—and secondly, in the introduction of cranes, power trucks and conveyor driers, with straight line flow to take advantage of such equipment. Recording and control instruments have made it possible to devise precise checks on certain operations—particularly those in which pH values are significant.

Chemical engineers, aside from their work directly in the industry, are rendering valuable services to tanners in supplying such essential materials as:

- 1—Vegetable tanning extracts such as quebracho
- 2—Chromium and aluminum compounds
- 3—Vegetable dyes such as logwood and fustic
- 4—Aniline dyes
- 5—Animal oils, for example cod oil
- 6—Mineral oils (often sulphonated)
- 7—Vegetable oils such as linseed
- 8—Pigments
- 9—Lacquers
- 10—Lime (of closely regulated properties)
- 11—Organic acids, for example lactic
- 12—Inorganic acids such as sulphuric
- 13—Inorganic salts such as sodium or arsenic sulphide

Beyond that, the chemical engineer is already aiding the tanner to realize more from waste materials such as:

- 1—Fleshings (for glue)
- 2—Trimmings, particularly calfskin (for gelatine)
- 3—Shavings and scrap (for leather board, fertilizer and so on)
- 4—Hair (for rugs, insulation, shell wadding, etc.)
- 5—Wool (from sheep trimmings) for textile fabrics

This rapid review of the chemical engineering that comes before and that which follows the tanning operations has built a vantage point, therefore, from which one can better appreciate the challenge of the leather industry to the chemical engineer. A brief discussion of the tanning and its preliminary processes follows:

Following take-off, skins ("skins" is to be understood as meaning either skins or hides) are either salted or dried for shipment. Either method inhibits bacteria growth and consequent decomposition. For long-time storage of the salted skins in the tannery cellar, however, refrigeration and temperature control may be needed.

Then follows soaking in cool water for from 6 to 72 hours. This is the first of many uses of water in the tannery—and this water can make or break the tanner. Perhaps the chemical engineer can closely relate the water

supply to tanning operations—if so there's work to be done! The "why" of the influence of the particular water used at various stages is not yet clearly understood. The object of soaking is to dissolve out the salt, soften the skin and cleanse it of surface dirt, extract certain undesirable skin proteins which are soluble in dilute salt solution and to replace any water of hydration removed by the salt. This operation has been carried out for years in rectangular wooden tanks set flush with the floor of the beam house, and agitated, if at all, by a partially submerged paddle wheel. Skins were dumped in singly, necessitating much handling in their loading and removal. Better agitation and rack or basket handling appear now in some plants but there is room for chemical engineering development.

The next step consists of an alkaline treatment which dissolves the keratinous substance holding the hair in the follicle, saponifies the skin fat partially and brings about other necessary chemical changes in the protein molecule. Owing to its low cost and little danger of misuse, lime is usually used. Unhairing time varies with the type of skin, the age of the lime and with the use or lack of added materials to speed up the action. Heavy cattle hides, for example, with normal liming may take 120 hours at 20 deg. C. Addition of sodium and arsenic sulphides to the lime is the older way to decrease unhairing time and works satisfactorily for many leathers, with the exception of the fact that the value of the hair may be impaired. Work is now being done with methylamine which is believed to be the active agent in old limes. Such liming is exceedingly rapid and appears to have no harmful effects upon either skin or hair.

As the practice is to move skins from tank to tank in order that limes of different unhairing power may be used successively on the skins, much handling is necessary. As in soaking, a number of plants have applied labor-saving devices here as well as in the occasional agitation of the limes. Again, better constructional materials than wood are commonly in use. Bearing in mind the practice of other industries, and of the vegetable extract tannery, it is possible that a successful counter-current system of liming will be discovered whereby the solution, not the skins, may be moved from tank to tank.

THREE TREATED SKINS then pass through an unhairing machine where the hair is removed. Washing, drying and baling this hair constitute a neat job of chemical engineering in many tanneries today and, as the value of hair increases, these operations are susceptible to further development. Following the unhairing, adhering flesh and fat are mechanically removed and usually are consigned to the glue works. Thereafter, depending upon its type and the character of the leather desired, the skin may be treated with an organic acid, such as lactic, to partially neutralize the lime or it may be subjected to the action of pancreatic enzymes. This is the modern equivalent of the ancient, and still sometimes used, bathing process. Hydrogen ion control is extremely important at this stage. Here again improvements in equipment may reduce handling and time.

The skins are now ready for the tanning proper. If vegetable extracts are used, the operation may take as much as 120 days. It is usually carried out in two stages. The hides are suspended in "rocker" vats from racks which can be given constant slow agitation. Material handling is reduced here through the use of such racks, and even more because the liquors are

pumped from pit to pit, for their strength must be built up. In some tanneries mechanical handling is employed for placing the skins and removing them from the "rockers." Much heavy vegetable tanned leather goes from this operation to the lay-away pits where it is packed with intervening layers of ground bark.

About half of our leather is now mineral tanned, usually with chrome or aluminum salts. Mineral tanning is more rapid than the vegetable and is usually carried out in a rotating drum, in a period of four hours or more.

Some engineers believe that handling methods, especially in the case of mineral tanning, can be considerably improved and that there is an opportunity here for the more effective application of power to the drums or "wheels." Then, too, this type of tannery may find chemical engineering assistance in equipment development.

Out of the lay-away pits or the chrome drums (parenthetically it should be noted that some tanners follow the first stages of the vegetable tanning process with chrome drumming while some actually combine the two in a single process) the leather is ready to be finished.

In brief, heavy leather is curried (stuffed with oils and greases to replace those originally existing in the hide), dried, rolled to compact the fibers and cut for shipment. Upper leather (typical of chrome process) is set out (partially dried by squeezing out the excess water), "fat liquored" and dyed (usually a single operation that both replaces natural oils and gives the leather color), dried, dampened, stretched, and then given the final desired appearance.

This may be obtained by buffing on an emery wheel (suede); by seasoning with several coats of a dressing containing such materials as pigments, glycerine, blood albumen and casein, followed by mechanical glazing, hot plating in hydraulic presses and hand ironing (full grain calf); or the surface of the leather may be embossed and colored by any one of several combinations of steps to obtain special grained surfaces.

One can indicate *all* of the opportunities for the chemical engineer in this industry only by pointing out in detail the practice of at least ten plants making as many types of leather. But a summary of these various practices will show, in particular, that opportunity is enhanced by the facts that—

- 1—Every tanner has to use, as raw material, hides and skins, no two of which are identically the same, but from which he must make a uniform product.
- 2—Every tanner has to conserve hide substance to make as much good leather as possible from the raw materials—and has to conserve byproducts in such form as to yield a maximum return.
- 3—Every tanner has to practice innumerable laborious operations, in many of which there is unfulfilled promise of the development of adaptable mechanical equipment.
- 4—Every tanner has to carry an excessive stock of material in process because of the time tanning takes.
- 5—Every tanner seeks to make good leather better.

Therefore the challenge is this: facilitate the making of better leather, in a shorter time, with less labor, with a higher yield and have the finished product measure up to even more rigid standards of uniformity.

Large Scale Titanium Pigment Production Based on Old Laboratory Process

By Bruce K. Brown

5 Nassau St., New York City

IN FEBRUARY of this year the Commercial Pigments Corporation began the production of titanium dioxide pigments and other titanium compounds. The first plant unit, now in operation, is rated at 10 tons daily capacity of titanium dioxide and produces about 40 tons of copperas (ferrous sulphate) as a byproduct. The process used is one originally developed by Dr. Joseph Blumenfeld of the Société de Produits Chimiques des Terres Rares, Paris, France. The plant is located at Curtis Bay, Baltimore, Md., on a plot of ground adjoining that occupied by the U. S. Industrial Alcohol Company. It was designed and constructed by the Bedford Construction Company. The plans were developed in consultation with the engineers of the European licensees of the Blumenfeld process who operate plants in France, Italy and Czechoslovakia.

The process used for the production of titanium dioxide is not a new one since it follows the same general lines of the earliest known analytical procedure for the determination and recovery of titanium. Adaptation of this analytical procedure to large scale operation, however, makes the process an interesting one, and few large scale inorganic chemical operations known to the writer require as careful control of colloidal phenomena.

Ilmenite ($\text{FeO} \cdot \text{TiO}_2$), the basic raw material in the

process, is laid down at the company's private docks on Curtis Bay as ballast cargo from India where the corporation controls the concession covering the famous Travancore beach deposit. The ore is in the form of a black sand, slightly magnetic and uniform in character. It is handled easily on belt conveyors and by means of chutes. No preliminary grading, sizing or crushing operations are necessary and raw material storage is a most simple matter since the product is not affected by the weather and may be stored in the open in large piles.

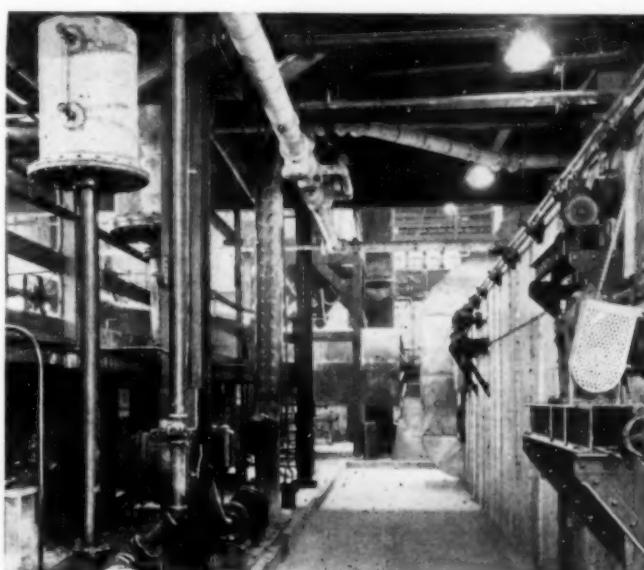


Fig. 1—View in the Plant of Commercial Pigments Corporation Showing, on the Left, the Supply Tanks for the Filters and, on the Right, the Acid Cake Drier

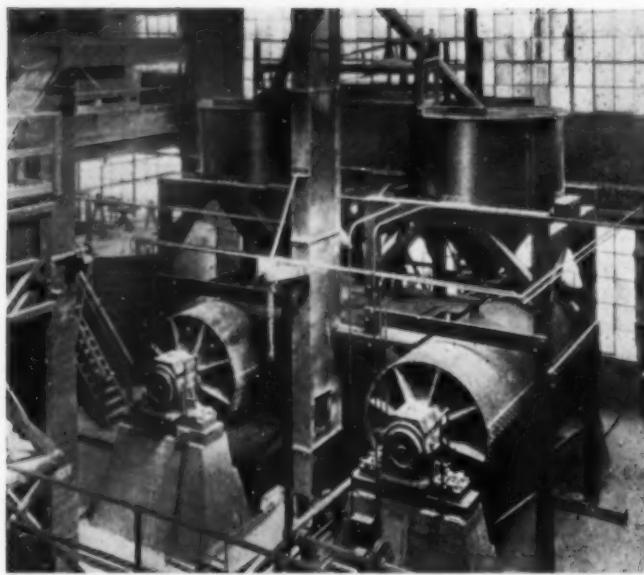


Fig. 2—Hoppers and Abbe Ball Mills for Grinding the Titanium Oxide Pigment

In the manufacturing operation the ore is conveyed by dump cars in weighed quantities to an overhead hopper. From this hopper it passes into "attack" pans which are oil fired and faced with acid-proof brick. Sulphuric acid of 60 deg. Bé., part of which is produced by the recovery of the dilute acid obtained in plant operations, is added to the ore with stirring and under controlled temperature conditions.

The product resulting from the acid reaction is a yellowish-brown dry sandy mass, which is dropped from the bottom of the attack pans into dump cars. The mass, although hygroscopic, contains but little free acid and is composed of ferrous sulphate, titanium sulphate, silica, and unattacked ilmenite. While it is possible completely to sulphate the ilmenite particles, this has been found to be an unprofitable operation since the shell of sulphates formed around the outside of the particles makes penetration to the center difficult. The attacked mass may be sent directly to subsequent operations or may be stored for an extended period if desired.

The reaction mass is then agitated with cold water and the solution thus obtained is treated in a Dorr classifier. In this manner a solution of ferrous sulphate and titanium sulphate is obtained and the unattacked ilmenite, amounting to from 15 per cent to 30 per cent of the original charge, is recovered, washed free of acid, and sent back to the reaction pans. The wash water from the ilmenite recovery contains acid and titanium values and is used in subsequent dissolving operations.

PRESENCE of ferric iron in the solution is undesirable and for this reason sufficient metallic iron is added to the solution to assure the reduction of all of the iron present to the ferrous state. The solution is then clarified to remove colloidal and suspended materials, and the "mud" obtained in the clarification operation is washed in a Dorr classifier to remove acid and titanium values. The clarified solution thus obtained contains approximately 150 grams TiO_2 , 125 grams of iron, and 500 grams of sulphuric acid per liter. The iron content of the solution is then reduced to about 25 grams per liter by cooling the solution to crystallize out ferrous sulphate which is removed by means of centrifugal filters. This solution is then hydrolyzed to produce titanium dioxide.

The fact that titanium sulphate solutions may be hydrolyzed to produce TiO_2 and free acid was discovered many years ago in connection with analytical procedures although this method has now been supplanted by more accurate methods. To secure complete precipitation of the "titanic acid," analysts worked with very dilute solutions and secured a complete hydrolysis only by a long boiling period. Such a procedure is not suitable for industrial operation since the economic success of the whole process must necessarily depend on the re-use of the acid generated by the hydrolysis. If this acid is available only in very dilute solutions, its profitable recovery and concentration is impossible. Concentrated solutions of titanium sulphate containing colloidal matter gradually hydrolyze at room temperature producing a low yield (35 per cent to 70 per cent) of a titanium dioxide unfitted for pigment use, and such hydrolysis is accelerated by dilution. Dilute crystalloidal solutions may be hydrolyzed by the application of heat but, as the concentration of sulphuric acid rises in the more concentrated solutions, the mixture becomes more stable. Crystalloidal solutions of titanium sulphate, containing from 400 to 500 grams per liter of sulphuric acid, may be boiled for long periods without hydrolysis.

After much effort a method was developed for the complete hydrolysis of concentrated titanium sulphate solutions to produce a product of desirable pigmentary properties. The control of this step must be very exact since slight errors in procedure may produce a gritty product of large particle size which has but little hiding power and a high oil absorption. The hydrolysis step is the subject of numerous patents and applications held by Commercial Pigments Corporation.

TIATNIUM dioxide obtained by hydrolysis is separated from the resultant solution of sulphuric acid by filtration in Sweetland presses. The acid thus recovered is sent to the concentration plant. The precipitate is washed free from mother liquor and is then repulped, subjected to additional washing operations, and is finally filtered on Oliver continuous filters. The moist precipitate thus obtained is dried in Gordon-Davis moving pan driers, and is calcined for about a half an hour in an oil fired muffle oven. The material is supplied to the oven through hoppers located on a charging floor above the oven. The calcined product is sent through another Gordon-Davis drier after which it is ready for use.

The titanium dioxide pigment obtained by this series of operations is characterized by having a higher hiding power than any other known white pigment. It is a very pure product, containing less than .005 per cent of total iron. Special processes developed by the corporation permit the production of a pigment having an oil absorption of about 25, which is considerably less than that of titanium dioxide pigments previously available on the market. The diversified uses and exceptional qualities of titanium dioxide pigments are so well known that they need not be discussed here.

This plant also produces titanium dioxide in the form of an unfilterable colloidal dispersion containing as much as 400 grams per liter of TiO_2 . Experiments have shown the value of this material in the production of refractories and mineral glues, and research has demonstrated the possibility of using it to replace tin in the weighting of silk and in other analogous fields.

Through co-operative research with foreign licensees of the Blumenfeld process, the company expects soon to introduce other titanium compounds.

CHEMICAL ENGINEER'S BOOKSHELF

Legal Chemistry of Foods

CRITICAL STUDIES IN THE LEGAL CHEMISTRY OF FOODS. By *R. O. Brooks*. The Chemical Catalog Company, Inc., New York. 280 pages. Price \$6.

Reviewed by PAUL D. V. MANNING

IN HIS preface the author states that this book was prepared in response to requests for reprints of his previously published papers. This prepares the reader for the fact that there is little material in the book which has not already been published in the trade and other journals. Some new matter (two chapters) has been put in the book and some of the work of other authors as well as that of several state experiment stations has been reprinted.

The new chapters by the author include the interpretation of a vinegar analysis and maple products analyses. The only other new material is a chapter by Eloise Jameson on pectin. Reprinted papers cover fruits and their products, vinegars, condiments, edible oils, cacao products, spices, standards and definitions, carbonated beverages, influence of sugar on jellies, mayonnaise and Federal labeling regulations.

The author's writings have an interesting and likable style but the publishers have not given the book a very pleasing appearance; considering this, its size and the predominance of previously published papers in the book, the price seems rather exorbitant.

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General Chemistry Newly Presented

INTRODUCTION TO GENERAL CHEMISTRY. By *William Martin Blanchard*. Doubleday, Doran & Company, Inc., New York. 588 pages. Price, \$3.

Reviewed by A. E. BUCHANAN, JR.

ONE cannot but appreciate the motive which prompts a teacher to write his own text—a desire to fit the text to individual methods of instruction and a keen sense of the student's reactions to the subject. As Professor Blanchard says in his preface, "the author of the present volume has consciously used the difficulties encountered by the average college student in the study of chemistry as his guide in the preparation of this text. His endeavor has been to present in a clear, concise and orderly fashion the more common facts and the fundamental laws and theories of general chemistry." This he has done, with evident pains to make the subject appealing by the introduction of full page portraits of eminent chemists, everyday examples and questions to illustrate fundamental principles. Thus, after his chapter on "Acids, bases and salts," the author asks, "In making gooseberry pie what would it be well to add before introducing the sugar?" While fully appreciating the psychology of this candy-coated instruction, somehow we sympathize with the inevitable wags who will perennially seize the opportunity to answer "gooseberries." In other words, we have a feeling that the introduction to chemistry is still largely a prosaic matter of queerly shaped glassware and equations, damned at birth by their relationship to algebra, instead of being admired as pictures full of life and substance.

Perhaps it is neither possible nor advisable to introduce chemistry as an inspiring glimpse into the marvelous precision and the immutable laws of nature, a yet entutored giant slave for man, a light which throws its beam into every corner of mortal ken, a romance, a philosophy. Probably Professor Blanchard is much more practical in seeking instead to improve the technique, as by presenting the subject of ozone in the chapter with selenium and tellurium instead of with oxygen, "because of its position in group six in consequence to its relation to oxygen." These reflections detract no whit from the careful, complete, thoroughly modern treatment Professor Blanchard has given his Introduction to General Chemistry. Indeed, it seems to the reviewer that the publisher was hardly justified in using as a jacket ornament the familiar laboratory dessicator.

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Sewage Disposal

THE DISPOSAL OF SEWAGE. By *T. H. P. Veal*. D. Van Nostrand Company, New York. 1928. 173 pages. Price, \$4.25.

Reviewed by GEORGE L. ROBINSON

THE AUTHOR has set forth in his preface the essential object of his book: it intends to cover the subject in such a way that the principles may be acquired without unnecessary detail.

From the standpoint of the American engineering student the book possesses much value as a condensed story of the development and progress of the science of sanitation in England. However, there is such a difference in conditions of climate, sewage flow and the practical operation of disposal works in the two countries that nothing is described that would be very helpful to our students in practice here.

The large number of illustrations help much in visualizing the mechanical methods employed and make clear the popularity of the traveling or revolving sprinkler. That so much space should be given to broad disposal or sewage farming is remarkable when such advances have been made in mechanical aeration. The book impresses as one to be used properly by undergraduates to supplement lectures on English practice.

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Compendium of Starch Chemistry

A COMPREHENSIVE SURVEY OF STARCH CHEMISTRY. Compiled and edited by *Robert P. Walton*. The Chemical Catalog Company, New York. 1928. Text, 240 pages; bibliography, 350 pages. Price, \$10.

Reviewed by R. E. GREENFIELD

STARCH occupies an extremely important place in modern industry but it has been exceptionally difficult for anyone to have a very comprehensive knowledge concerning the properties and uses because such information is widely scattered—ranging, as it does, from the most technical of the scientific journals to various trade journals, house organs, and even secret files of the industrial laboratories. This book, which has for its aim "to correlate the divergent types of investigations in the field, provide the researcher with an encyclopedia of

previous observation and to furnish to those indirectly interested a ready available exposition of the subject," will be welcomed by all.

The second part of the volume consists of an extensive bibliography of starch chemistry from 1811 to 1925. The indexing is good, brief abstracts are included and references are given to other abstract sources as well as the original. Such a bibliography, in itself, will do much to fulfill the first two aims of the book.

The first part of the book consists of a synopsis of starch chemistry and technology by twenty contributors, each recognized as an authority in his field. The synopsis includes discussions of the molecular structure of starch as indicated by the various decomposition products, the nature of amylases, the structure of starch as indicated by X-ray, and a survey of the manufacture and technical uses of starch. A brief but very interesting statement of the early history of starch chemistry serves to supplement the bibliography.

The need for such a synopsis is quite clearly brought out by the striking differences in theory and nomenclature which are to be noted even in the more purely theoretical chapters. If the book as a whole, and more especially the portions devoted to industrial applications, were read for the purpose of finding faults much might be found to criticize, for as might be expected, some chapters cover their field more thoroughly and show signs of more careful preparation than others, and in places there is a lack of completeness. For example, the manufacture of only corn starch and potato starch is covered although the importance industrially of other starches is clearly brought out; malt conversion for the brewing industry is discussed but acid conversion for the manufacture of corn syrup and sugar is hardly mentioned. The excellent way in which the field has been covered in such a brief text far outweighs such faults and it is much to be hoped that the second volume, which is to cover patents in this field, will be as satisfactory.

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The Rare Gases in Abegg

DIE ELEMENTE DER ACHTEN GRUPPE DES PERIODISCHEN SYSTEMS. Erster Teil: DIE EDELGASE. By Eugen Rabinowitsch. Abegg's Handbuch der anorganischen Chemie. S. Hirzel, Leipzig. 1928. 522 pages. Price, 48M.

WHILE this rather sizeable book forms only a part of Abegg's well-known "handbook," like its companion volumes it also represents an independent exhaustive treatise on its particular subject, the rare gases. Unlike its predecessors, however, it is the work of a single author—a circumstance made possible by the comparative newness of the material and one that allows of a desirable coherency of treatment.

The rare gases have been clearly recognized as individual chemical elements only within the past 35 years, but the wealth of knowledge that has been disclosed and yielded by them in that time appears quite out of proportion to their occurrence and present general applicability. The author of this volume has accomplished a very thorough work in critically recording the full fund of knowledge and research on this peculiar group of elements. His first and most general section deals with the occurrence, production and uses of the rare gases; but even here there is a thoroughness and attention to detail that must seem exhaustive. The subsequent parts view the gases with reference respectively to their nuclear, atomic and molecular properties. The material falls pre-eminently into the field of pure science and

can scarcely be of aid to a man not priorly acquainted with that field; but to the scientist whose interests are at all related it represents in itself a sort of "handbook." A very extensive bibliography and a large number of graphs and cuts complete the equipment of the work.

Since the death of the original editors, R. Abegg and F. Auerbach, Dr. I. Koppel of the University of Berlin has assumed charge of the completion of the series. The publisher has contributed conspicuously to the volume through its splendid typography and general dignified appearance.

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New TAPPI Publications

PAPER TESTING METHODS. Prepared by the Committee on Paper Testing of the Technical Association of the Pulp and Paper Industry. Lockwood Trade Journal Company, New York. 126 pages. Price, \$3.

THE CHIEF functions of the Paper Testing Committee of T.A.P.P.I. are to develop and to standardize paper testing methods. The pioneering work in development of American standards for paper testing was directed by Frederick C. Clark, of the East Hartford Manufacturing Company. The first pamphlet on the subject was published by the Clark committee in 1920. B. W. Scriber of the U. S. Bureau of Standards, is present chairman of the committee, and this revised edition of Paper Testing Methods is eloquent testimony to the activity of his committee. A number of new methods of testing have been adopted by the Technical Association and are included in this new edition, which is very complete and attractively presented.

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CHEMISTRY OF THE SULPHITE PROCESS. Collection of papers by R. N. Miller, W. H. Swanson, M. W. Bray, R. Söderquist, T. M. Andrews, and W. H. Monsson, for the Technical Association of the Pulp and Paper Industry. Lockwood Trade Journal Company. 166 pages. Price, \$3.

Being the results of investigations systematically carried on at the United States Forest Products Laboratory since 1921, these papers represent a coherent examination of the sulphite process of wood digestion. Though completed at different dates during a six-year period, they have the merit of being scientifically well-grounded, in spite of the additional knowledge that has been gained since the earlier papers. This is particularly true in regard to conclusions drawn by the authors; where they have since been shown to need modification, the research underlying them remains a valuable scientific contribution and should stimulate others to carry on this work with a fresh impetus.

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Manual of Colloids

LABORATORY MANUAL OF COLLOID CHEMISTRY (Second Edition). By Harry N. Holmes. John Wiley and Sons, New York. xviii + 228 pages. Price, \$3.

Reviewed by HARRY B. WEISER

PUBLISHED for the first time six years ago, this revised and enlarged edition of the author's manual now consists of 225 experiments grouped under the following chapter headings: Suspensions—Coarse and Fine; Dialysis, Diffusion and Ultrafiltration; Condensation Methods of Preparing Sols; Dispersion Methods of Preparing Sols; Electrical Properties, Electric Osmose and Electrophoresis; Coagulation or Flocculation; Protective Colloids; Surface Tension—Interfacial Tension; Emulsions; Froths and Films; Solvated Colloids or Gels; Soaps; The Colloid Chemistry of Proteins; Reactions in

Gels; Viscosity and Plasticity; Adsorption from Solution; Adsorption of Gases; Aerosols; Soils and Clays; Special Topics.

As the chapter headings indicate, this volume presents a comprehensive survey of the whole field of experimental colloid chemistry both theoretical and applied. Each set of experiments is prefaced with a theoretical discussion accompanied by numerous references to the literature and a selected list of reference is appended to each chapter. The less familiar and more complicated experiments are described in great detail and special attention is called to the chief sources of error in the experiments.

This is an excellent laboratory manual, the most complete and thorough of its kind. Every teacher and student of colloid chemistry will find the volume indispensable.

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A COMPREHENSIVE TREATISE OF INORGANIC AND THEORETICAL CHEMISTRY. By J. W. Mellor. Longmans, Green and Company, New York and London. 1928. 1110 pages. Price, \$20.

VOLUME VIII of Dr. Mellor's deservedly famous treatise is devoted to nitrogen and phosphorus with their compounds. As each volume of this masterful work appears, one marvels anew at its comprehensive character and its meticulous accuracy. Every important contribution to the knowledge of nitrogen, phosphorus and their compounds made by scientists of the whole world has been digested and is spread before the reader in apple-pie order, so that he may either satisfy his curiosity at once by a pithy summary or find complete references to the original sources of detailed information. It is pleasant to find the familiar Mellor quotations at the beginning of each chapter, for they are symbolic of the human touch that lifts the "Treatise" a bit above the encyclopedia class and they reveal, perhaps, the true artistry that inspires the author in his monumental effort. Dr. Mellor's volumes must be vertebræ in the backbone of every chemical library for years to come.

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ANNUAL REPORTS OF THE SOCIETY OF CHEMICAL INDUSTRY ON THE PROGRESS OF APPLIED CHEMISTRY. Vol. XII, 1927. Society of Chemical Industry, London. 643 pages.

THIS volume is a comprehensive survey of developments during 1927 in the chemical and process industries. An authority in each field has reviewed the important contributions to technique, research and literature in that industry. Economic trends and production statistics are also summarized in most cases. The book gives an excellent picture of the activities in the chemical engineering industries abroad and, by its impressive dimensions, bears eloquent testimony to their aggressive progress during 1927.

* * *

THE ENGINEERING INDEX, 1927. American Society of Mechanical Engineers, New York. 898 pages. Price, \$8.50.

This standard reference book is too well known to need description. By abstracting the worthwhile contributions to technical literature which appeared during the year in over 700 periodicals, the Engineering Index supplies one of the most vital and valuable working tools of the engineer.

In connection with the present volume it is interesting to note the extension of this service of the Engineering Index on Jan. 1, 1928, when the number of periodicals reviewed was increased to 1,700. A weekly card index service is now provided. The publications

now being reviewed represent 37 countries and 17 languages, and cover every phase of engineering activity including mechanical, civil, electrical, mining and metallurgy, management, and the like.

* * * *

THE STORY OF CHEMISTRY. By Floyd L. Darrow. Bobbs-Merrill Company, Indianapolis. 528 pages. Price, \$4.

As may be suspected from the title, *The Story of Chemistry* is science à la mode, prepared especially for non-technical readers. In the words of the publisher, "it neither shoots over the head of the general reader nor talks down to him."

The impression one gets from reading the book is that the author must have carried a notebook constantly and noted therein every item discovered in his conscientious perusal of technical journals, popular scientific articles and newspapers, which seemed to fit in "the story of chemistry." In this respect the book recalls "Everybody's Business," but the staccato style of Floyd Parsons is replaced by a wordiness which, while giving continuity, rather "denatures" the dose. Intelligent readers without up-to-date knowledge of industrial chemistry will learn a lot from the book and perhaps even catch some of the author's evident enthusiasm for his subject.

* * * *

THEORIE DER REDUKTIONSFÄHIGKEIT VON STEINKOHLENKOKS. By Georg Agde and H. Schmitt. Wilhelm Knapp, Halle, Germany. 1928. 165 pages + supplement. Price, 18.50 M.

AS THE eighteenth volume in the series entitled "Kohle-Koks-Teer," this book considers the reducing properties of anthracite coke. The problem being of a complex nature, the very considerable work done upon it in the past (with renewed effort since the war) has never been satisfactorily combined. The authors select and group the important determinations up to the present and weigh them critically. It is their own conclusion, prompted by further research, that the behavior of anthracite coke depends upon both the relative quantity of carbon and the surface exposed by an average lump. The supplement comprises 39 pages of experimental and illustrative graphs.

* * *

ABMESSUNGEN VON HOCH-UND MARTINÖFEN. By Michael Pavloff, trans. from the Russian by F. Dreyer. Otto Spamer, Leipzig, 1928. 140 pages. Price, 16 M.

The present volume is an addition to a new series of monographs intended to cover the subject of industrial furnaces and ovens—one of the most neglected fields in technical literature, according to the editor. Its own territory is restricted to the blast and open-hearth furnaces, which are described with regard to development, types, and dimensions. Additional matter includes chapters on heat technology and on the designing of furnaces according to the available data. The book is well equipped with more than 150 cuts.

* * *

SOLFATO DI RAME. By E. Crivelli. Ulrico Hoepli, Milan. 321 pages. Price 35 lire.

A comprehensive treatise on copper sulphate manufacture. Italy produces almost as much of this salt as all the rest of the world together. The methods used in its production are therefore interesting, particularly for the completely modern plants described in this book. In addition to covering the technology, the author tabulates statistics, discusses economic factors and gives a bit of interesting historical background of the industry.

Selections from Recent Literature

ACETYLATING WOOD. W. Fuchs. *Berichte* 61, 948-51 (1928). A procedure for acetylating fine fir sawdust or like wood wastes is outlined. Acetic anhydride is used, and the acetyl content is brought up as high as 43 to 44 per cent. The saponification behavior is compared with that of acetyl cellulose.

CELLULOSES. Scheiber. *Farbe und Lack* 1928, 210-1. A critical discussion of the properties of celluloses from various sources, with respect to their suitability for nitration or esterification. Illustrated with photomicrographs.

ARTIFICIAL LEATHER. P. Martell. *Kunststoffe* 18, 106-7 (1928). A review of methods of making the two types of leather substitutes, namely those derived from scrap leather or leather dust, and those made with a fabric base. Particular attention is given to the pyroxylin leathers.

CELLOPHANE. *Chemiker-Zeitung*, 52, 366-7 (1928). Historical sketch of the origin and manufacture of cellulose hydrate from viscose; present practice in production; uses in thin sheet form for wrappers and the like.

CASEIN. C. Porcher. *Chimie et Industrie* 19, 589-98, 809-16 (1928). A comprehensive review of the chemistry of casein and of its precipitation by acids or by ferments, and its hardening for production of the numerous casein compositions and materials used in industry. Emphasis is on the preparation of casein for use rather than on its actual uses.

PLASTICIZING. O. Manfred. *Revue générale des matières plastiques* 4, 67-71, 139-51, 201-11 (1928). A review of various treatments used for improving the plasticity of plastic materials and the effects of these treatments on the physical (mechanical) properties of the treated substances. Emphasis is on the casein plastics.

PLASTICS. J. Obrist. *Kolloid-Zeitschrift* 45, 82-92 (1928). A review of recent advances in the chemistry and technology of cellulose esters, synthetic resins and the casein type of plastics. Colloidal structure as related to properties of plastics is discussed.

SOAKING LEATHER. E. R. Theis and E. L. McMillan. *Journal of the American Leather Chemists Association* 23, 226-33 (1928). A critical study of the biochemistry of the soaking process. It is shown that soaking partially destroys the amino acids (arginine, histidine and lysine) and that the loss of nitrogenous matter to the water increases with time.

ACCELERATED TANNING. I. Waissberg. *Gerber* 54, 81-3 (1928). The rapid tanning methods developed at the Taganrog tannery in Russia are briefly described. There is little or no sacrifice of quality in the finished leather on account of the greater speed of production. Sole leather tanning is emphasized.

FILTRATION. J. A. Pickard. *Industrial Chemist* 4, 186-90 (1928). The mechanical basis of filtration processes involves chiefly the porosity of the medium and the particle nature of the material to be filtered. Pore length is nearly as important as pore diameter; and the choice of medium is largely governed by the hardness, size, uniformity and other properties of the material. Illustrated.

SOLVENT RECOVERY. *Industrial Chemist* 4, 191-8 (1928). The method of recovering volatile solvents by absorption of the vapor with active carbon, as developed by Bayer, has several advantages over the distillation and scrubbing processes. The method and equipment are described; flow sheet, diagrams and photographs are shown.

SORPTION AND CATALYSIS. Otto Schmidt. *Zeitschrift für physikalische Chemie* 133, 263-303 (1928). Catalysis of gas reactions is intimately bound up with the theory of sorption of gases by porous solids. The sorption equation is developed. It also holds for colloids and liquids. Illustrated with many curve charts showing sorption by various catalysts.

ORE MILLING MACHINERY. *Canadian Chemistry & Metallurgy* 12, 131-2 (1928). A review of recent advances in machinery for filtration, classifying, thickening, mixing and grinding, with special reference to the processing of ores.

WATER GLASS. M. von Reiboldt. *Chemiker-Zeitung* 52, 345-6 (1928). Description of the best practice for melting alkali and silica for water glass production. Melting tank construction is an important factor in successful operation. Difficulties and their causes are considered.

DYEING LEATHER. H. Salt. *Journal of the Society of Dyers & Colourists* 44, 134-5 (1928); discussion, p. 135-7. A theory of dyeing as related to the amphoteric nature of hide substance, gives a satisfactory explanation of why leather takes up acid and direct colors but not basic dyes.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for issue.

Standard Samples. Supplement, dated April 24, 1928, to Bureau of Standards Circular 25, which lists standard samples of ores, metals, and other standard materials issued by the Bureau of Standards for use by laboratories in

checking analytical methods or calibrating equipment.

Concentration in the Italian Chemical Industry, by Assistant Trade Commissioner E. Humes, Rome. Bureau of Foreign and Domestic Commerce, Chemical Division, Special Circular 206.

Corrosion Embrittlement of Duralumin, by Henry S. Rawdon, of the Bureau of Standards. Issued in four parts by the National Committee for Aeronautics, as Technical Notes Nos. 282, 283, 284 and 285.

Electro-Furnace Cast Iron, by C. E. Williams and C. E. Sims. Bureau of Mines Technical Paper 418. 10 cents.

Spontaneous Heating of Coal, by J. D. Davis and D. A. Reynolds. Bureau of Mines Technical Paper 409. 20 cents.

The Mining of Gilsonite in Utah, by W. J. Fene. Bureau of Mines, Information Circular 6069.

Mineral Production Statistics for 1927 — preliminary mimeographed statements from Bureau of Mines on: platinum and allied metals, metallic cadmium, asphalt, Portland cement, natural abrasives, copper and manganese.

Soil—Corrosion Studies. I, Soils, Materials, and Results of Early Observations. By K. H. Logan, S. P. Ewing, and C. D. Yeomans. Bureau of Standards Technologic Paper 368. 50 cents.

* * *

Miscellaneous Publications

Profitable Application of Electric Industrial Trucks and Tractors in Industry. Published by the Society for Electrical Development, Inc. This 96-page, well-illustrated book was undertaken with the co-operation of some twenty manufacturers of electrical equipment, who seek to acquaint the reader with the various practical uses of the apparatus described.

Die Verflüssigung der Kohle Nach Fr. Bergius — Eine technologische, wirtschaftschemische Studie, by Dr. Walter Friedmann. Published by the Allgemeiner Industrie-Verlag, G. m. b. H., Berlin, Germany. Sixty pages long, this booklet deals principally with the Bergius process for liquefaction of coal and covers its development and prospects. However, no references such as patent numbers, journal names, and page numbers are given, which one would expect to supplement an otherwise satisfactory treatment.

"Industrial gas heating" is an attractive booklet issued by the American Gas Association illustrating gas-fired industrial equipment for many process industries. The types of furnaces and specially designed unit apparatus shown suggest numerous other means for modernizing plant operations. Those interested can obtain a copy and additional information on industrial heating from the headquarters of American Gas Association, Graybar Building, New York City.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Small Electric Boiler

BY ALBERT RUDIN
Abangares, Costa Rica

The small electric boiler described herein has been in use for about a year for distilling water and supplying steam under pressure, for operating small evaporating pans, autoclaves, and so on. It has given excellent service and has proved so convenient that the details of construction are likely to be of interest to others.

The boiler is of the type in which the water itself acts as the resistance and is so arranged that regulation is entirely automatic. Current consumption exactly follows the demand for steam and the steam pressure remains at all times within a pound or two of the pressure of the water used for feeding the boiler.

The capacity of the boiler, under the conditions with which it has been used, is slightly under 2 boiler hp. The boiler will supply continuously about 53 lb. of steam per hour at, for example, a pressure of 40 lb. gage when city water of this pressure is available. The over-all efficiency of the boiler is quite high as 90 to 95 per cent efficiency is easily obtainable if the boiler and surge tank are well insulated. The power requirement has been found to

be such that 1 kw. will evaporate about 3.5 lb. of water per hour at 212 deg. F.

The boiler and surge tank are shown in some detail in the two accompanying drawings. Within the shell of the boiler are three tubular electrodes made of 1½-in. iron pipe, connected to the outside through insulating porcelain bushings. The circuit of three-phase, 220-volt current is completed between the electrodes by the water which is consequently heated and evaporated. The boiler can be put in service in a very short time. It requires six minutes to produce steam at atmospheric pressure while a total of eight minutes is necessary for steam under 40 lb. pressure.

Three-phase current is most convenient for operation, but a single-phase boiler can be designed with two electrodes, or a two-phase boiler with four. On account of the low conductivity of water, it is preferable to use 220 or even 440 volts if available. The use of 110 volts will cut down the capacity of the boiler to about one-fourth. Obviously, the boiler must not be operated with direct current, as electrolytic action will be set up, producing an explosive mixture of oxygen and hydrogen.

If the boiler is connected directly to the city water supply through the surge tank, steam at approximately city water pressure will be supplied. If steam is needed at a pressure not much above atmospheric, a secondary feed tank, set at a height corresponding to the pressure desired, is used in which the level is maintained by a float valve.

In putting the boiler in service, the following procedure has been found to be most effective. The boiler is filled to a point slightly above the level of the top of the electrodes and the water supply valve is closed. A steam valve is left open so that the noise of escaping steam will serve as a signal that further attention is required. As soon as steam escapes the steam valve is closed and the pressure rises until it equals the water pressure, when the water valve is opened and the boiler is ready for work.

When the steam has reached water pressure and the water valve is opened, it is obvious that if steam be produced at a rate greater than the demand, the pressure will build up above water pressure and force some of the water from the boiler down into the surge tank. This will uncover a part of the electrodes and reduce the power consumption. In case no steam is used, the whole of the electrodes will be

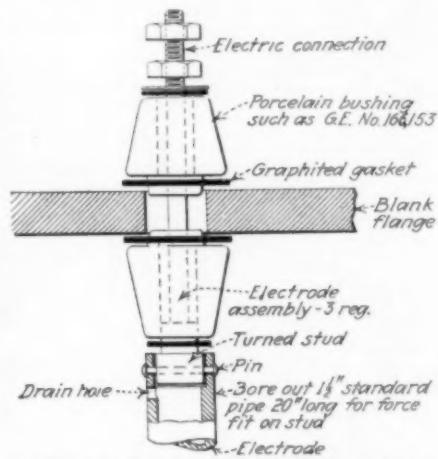


Fig. 2—Detail of Electrode Assembly

uncovered, cutting out the current completely. However, the water level will soon rise again and after a few oscillations will adjust itself automatically to such a height that power consumption will just equal the heat losses.

When steam is again used, the inside pressure will drop slightly, allowing more water to come into the boiler. Thus an increase in the effective area of the electrodes results and more power is consumed. This adjustment is entirely automatic and after a few oscillations the water level becomes quite steady as long as there is no change in steam demand. The adjustment is facilitated if the water supply valve be only partially opened so as to retard the swings and exert a damping effect. The best opening for this valve is found experimentally. If it be throttled too much, it will permit too high a pressure inside the boiler before the excess water can be pushed back into the surge tank. Conversely, the pressure will drop more than it should if the demand for steam increases too much.

From the above, it is evident that the apparatus is entirely safe, even without a safety valve, under normal conditions. However, should the water supply valve be left closed while the current is on, pressure will naturally build up, and for this reason a safety valve, set about 5 lb. above water pressure, is connected to the boiler.

As the water in different localities varies in conductivity, it cannot be said definitely what is the proper immersion for the electrodes. The water with which the boiler has previously been used gave an immersion of 14 in. However, the boiler will take care of this automatically. A smaller boiler, which was formerly used, was made without the surge tank. It has been found that

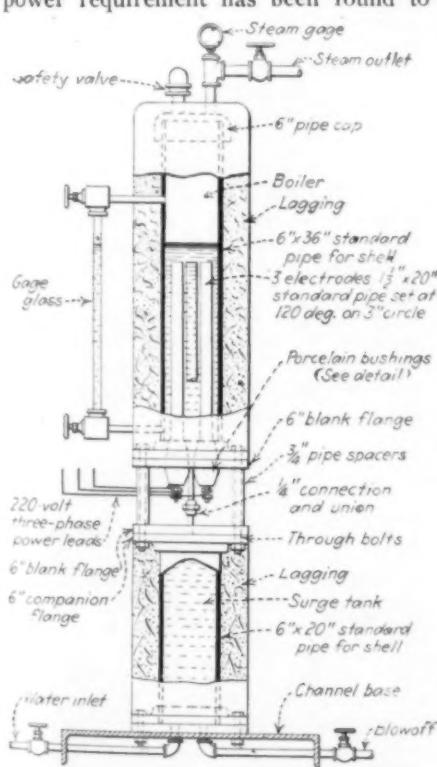


Fig. 1—Partial Sectional Elevation of Boiler and Surge Tank

the use of a lagged surge tank results in improvement in the efficiency of operation of the boiler. The reason is that the heat in the water which is pushed back from the boiler is conserved and not lost in the lines as it would be in case no surge tank were used.

Protecting Liquid Meters from Corrosion

By F. M. AHR
Dayton, Ohio

In measuring the flow of corrosive liquids or those that tend to interfere with the free movement of the delicate parts of the meter, considerable difficulty is often experienced in maintaining continuous operation of the meter. This is true of the type of meters operating by the differential pressure across orifices, Pitot tubes, Venturi throats, and so on, where the liquids do not pass directly through the meter itself, as in displacement meters.

The liquid in these meters remains stationary in the meter body, the reading being controlled by a change in level of mercury in the bottom of the meter. A very good method of eliminating the corrosion is by the use of a non-corrosive liquid in the meter, such as high grade mineral oil. The liquid metered acts upon the transmitting medium such as the oil, which affects the level of the mercury in the same proportion as though the liquid itself filled the meter.

The use of liquids lighter than that metered and immiscible with it is best because they can be most easily sealed in the meter and prevented from seeping into the moving stream. This is accomplished as illustrated, by using two small tanks, made say of 6-in. pipe about 18 in. long, capped at each end. The meter connections are screwed into the top of their respective containers, one container being furnished for each side, low and high pressure. The connections from the pipe line orifice or Venturi tube extend down to the bot-

tom of the containers to keep the lighter oil sealed above. If the metered liquid is lighter than the transmitting medium, the above connections are reversed. On the side of each container there should be a gage glass or several try-cocks to indicate the separation level of the two liquids. There should also be a tap with a valve upon which to attach a funnel for adding more transmitting liquid in case of loss. This is added with the pressure shut off the meter. A drain must be supplied to each container for cleaning. This arrangement will not affect the accuracy of the meter, but will protect its interior mechanism from the action of the liquid metered.

Such protection containers may also be used for other instruments such as pressure gages and indicators.

Speed Reducer Comparisons

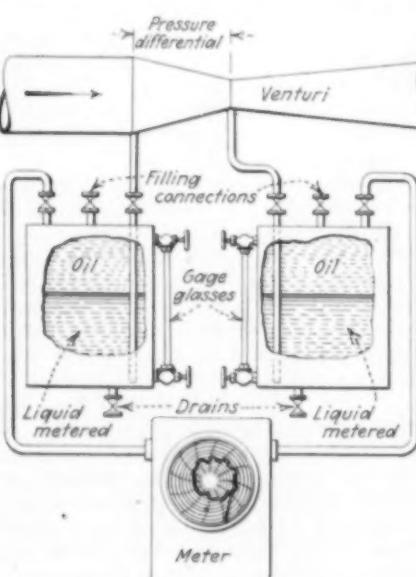
Determination of the proper types of speed reducers for various needs was the subject of a discussion by F. A. Emmons of Foote Bros. Gear and Machine Company, printed in a late issue of *Power Transmission*. A summary of the comparative advantages and qualifications of the four principal types of reducers was given and has been reproduced herewith. The operating man will find the comparison useful.

In the table are listed spur gear reducers, including planetary, non-planetary and multiple back gear types; herringbone gear reducers; and two types of worm reducers—the commercial and the special types. The former refers to the old style type with ordinary commercially cut worm and gear, plain sleeve bearings and of lower priced construction. The special type makes use of anti-friction bearings and specially designed and machined gear parts. The order in which the several reducers meet the various criteria is indicated by numbers, with (1) as the best, (2) as the second and so on.

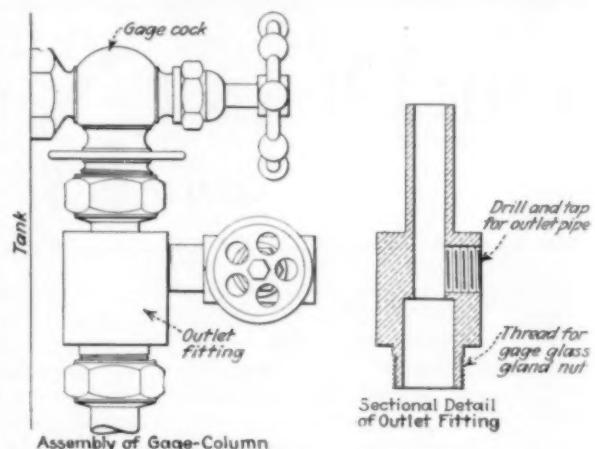
General Selection Data for Speed Reducers

| | Spur | Herringbone | Commercial Worm | Special Worm |
|---|---------------|-----------------|-----------------|--------------|
| Approximate efficiency | 2 | 1 | 4 | 2 |
| Overload capacity | 1 | 2 | 3 | 2 |
| Quietness | 3 | 2 | 2 | 1 |
| High speeds | 3 | 1 | 2 | 1 |
| Ratio, up to | 400 | 300 | 100 | 2,500 |
| to 1 | to 1 | to 1 | to 1 | to 1 |
| Direction of drive | Straight line | Parallel offset | Right angle | Right angle |
| Vibration | 3 | 2 | 2 | 1 |
| Life | 1 | 1 | 3 | 1 |
| Initial cost | 2 | 3 | 1 | 4 |
| Ability to carry overhung loads without outboard bearings | 6 | 5 | 6 | 5 |
| Ability to carry shock loads, overloads, and reversals | 2 | 1 | 2 | 1 |
| Space required | 2 | 3 | 2 | 1 |
| Continuous service | 2 | 1 | 3 | 1 |

¹100% momentary. ²25% continuous. ³25% continuous with conveyor worm gear. ⁴No. ⁵Reasonable. ⁶Small.



Protection Containers Installed on a Flow Meter



Temporary Outlet Fitting Installed in a Gage Cock

Temporary Tank Connection

By F. L. KALLAM
South Gate, Cal.

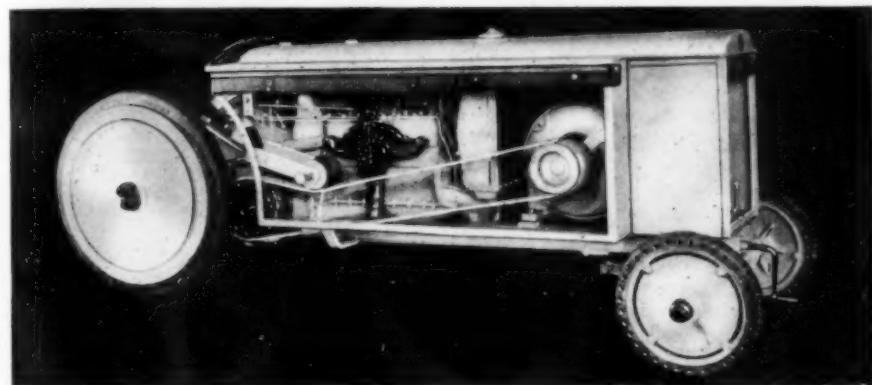
An additional connection to a pressure vessel is often required although it may not warrant placing the apparatus out of service for making the change, or it may be uneconomical to close down the operating system for this purpose alone. Such was the case where it was found necessary to install an automatic level control device on a gasoline-water separator. Here a connection, formerly a bottom drain, was available for the liquid connection to the float box, but no vapor connection could be found leading into the vapor space of the separator. Fortunately, the tank was equipped with a gage glass column, so that the idea was conceived of utilizing the upper gage cock for the vent connection. As the plant operation required the use of the level glass, a brass outlet fitting was devised, as shown in the accompanying drawing. This was inserted into the upper gage glass cock in the same manner as the customary glass. The bottom portion of this outlet fitting was fashioned into a gage glass gland which permitted the replacing of the gage glass after it had been properly shortened, for use with the separator. The vapor vent was then connected into the valve in the outlet fitting. This arrangement functioned very satisfactorily for several months after which the plant was closed down for numerous repairs, when a permanent vapor connection was made in the top of the separator.

Globe Valve Strainer

A recent issue of *Power* contains a suggestion for using an old globe valve in making a pipe line strainer. The stem and disk of the valve are removed and a piece of screening, rolled to a cylinder is fitted tightly into the valve body so that it rests upon the seat and may be held in place by screwing the bonnet into position. A metal disk and some leather packing secured in the stuffing box by the gland nut effectively seal off the stem opening through the bonnet.

EQUIPMENT NEWS

from MAKER and USER



New Improved Welder-Tractor Combination

Tractor Welder Combination

An improved combination of electric arc welder and Fordson tractor is now offered by the General Electric Company, Schenectady, N. Y. Although the older combination outfits were not sold by this company, it is marketing the improved model directly.

The principal improvements consist in the substitution of a new type of welding equipment with the addition of a protective covering and head and tail lights on the tractor. The combination consists of a standard Fordson tractor, belt connected to a 25-volt, 300-ampere ball bearing generator. Other features include a governor, power take-off and so on, incorporated in a weather-tight construction. Standard equipment provides industrial type rubber-tired wheels. The entire arrangement is indicated in the illustration.

The complete unit has an overall length of 12-ft. and weighs approximately 4,900 lb. It is intended primarily for work in the field and as such may be used to haul equipment and tools to the job. It is also, however, recommended for shops where a readily portable welder is required.

Manhole Cover

A new manhole cover embodying the locking principle of the Kelly filter press has been introduced by the United Filters Corporation, Hazelton, Pa. This locking mechanism is doubtless generally familiar through its earlier association with the Kelly press. It is shown in the accompanying illustration which makes clear the fact that by screwing down on the capstan, the dogs slip under suitable clamps on the equipment to which the cover is attached. The capstan screw may be worked by

hand or arranged for power control. The manufacturers recommend the new cover particularly for large apparatus where it is difficult to keep a large, frequently removed cover tight.



Kelly Locking Mechanism Applied to a Manhole Cover

Experimental Kneader and Mixer

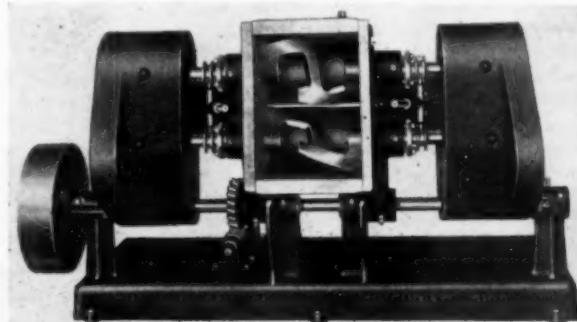
The attached illustration shows a new type of mixer which has recently been placed on the market by the J. H. Day Company, Cincinnati, Ohio. This is one of a line of experimental machines which are known as the "Mogul" series and which are arranged for easy removal and changing of the agitators. At either side of the mixing tank is shown a lever which, when pulled back, releases one end of both agitators. The agitators may then be removed and replaced or turned around to give different mixing effects. For experimental work it is thus possible with one machine to

try different types of agitators or different arrangements of the same type to conform with various mixing or kneading requirements. For instance, the set of agitators may be arranged in three different ways, either to mix the mass toward the ends of the tank, toward the center of the tank, or toward the center for one agitator and toward the end for the other. The mixing tank is arranged to be tilted by means of a hand lever. All gears remain enmeshed in the tilted position so that the tank may be run while tipped. The machines are heavily built and the gears completely guarded. Air tight covers may be provided and the mixers may be run either under pressure or vacuum. Special agitators and saddles may be provided for pulping and shredding operations. Tanks may be supplied jacketed when desired. The machines are available in various capacities, materials and types, regarding which further information should be obtained from the manufacturer.

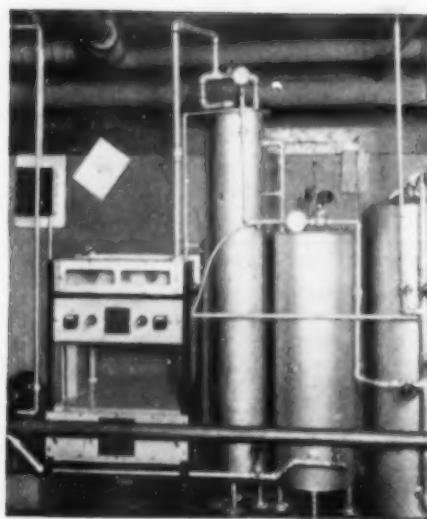
Ozone Sterilizer

A new entry into the field of water purification equipment is the Electrozone water sterilizer manufactured by the Air Conditioning & Engineering Co., 2914 South Jefferson Ave., St. Louis, Mo. The sterilizer, shown herewith, uses ozone to destroy the pathogenic bacteria in water and to effect a considerable degree of deodorizing and decolorizing through the quite complete destruction of organic matter in the water.

The sterilizers are supplied in sizes of 150, 300 and 600 gal. per hour capacity. Larger sizes, however, may be supplied upon request. The equipment consists of an ozonator, ozone mixer, a contact reserve tower, additional purified water storage capacity if necessary, and equipment for automatic con-



Experimental Kneader and Mixer with Removable and Interchangeable Agitators



Sterilizer for Ozonating Water

trol and the necessary piping connections. The equipment at the left of the illustration consists of the ozone generator complete with an air filter, a reactivating dehydrator, and the necessary auxiliary equipment and control board. Above is the ozone mixer where water is emulsified with ozonized air and then delivered to the bottom of the contact reserve tank. A float control in the latter tank automatically governs the operation of the entire apparatus and maintains a constant level of sterilized water when the apparatus is being used to less than full capacity.

The new sterilizer is intended primarily as a source of pure drinking water supply, but is also recommended for use in connection with the manufacture of food products and beverages. It should be noted, as is claimed by the manufacturer, that chlorine tastes in water are destroyed by ozonation.

Variable Sensitivity Balance

An interesting analytical balance has been developed and announced by Wm. Ainsworth & Sons, Inc., Denver, Colo. The new balance has as its principal features of novelty provisions for variable sensitivity and for the elimination of handling of the fractional weights. The latter feature gives the instrument its name of "Multiweight" balance.

The variable sensitivity is accomplished through dropping a weight of considerable magnitude upon a stud attached to the indicator when beginning a weighing, thereby decreasing the sensitivity 10 or 20 times according to the weight used, and increasing the speed of oscillation by 6 or 12 times, respectively. When approximate balance is reached, the weight is lifted with the balance still in motion and the weighing completed at normal speed.

The elimination of fractional weight handling is accomplished by having each weight or rider carried on an arm within the case. A sliding selector extending through the right-hand end of

the case is used to transfer the weights, as required, to a bar attached to the right-hand stirrup. Weights up to 1,115 mg. may be added in this manner. A single motion of the selector returns all the weights to their respective arms.

Unit Humidifier

The new Type I Humidifier, a product of the Clarage Fan Company, Kalamazoo, Mich., offers in one unit a heater and humidifier, or if provided with a cold water connection, a dehumidifier, if desired, which is adapted to the air conditioning of any small space or single room. A battery of the units for conditioning an entire factory building has the advantage that plant changes may easily be made as there is no duct system required. The unit is now supplied in two sizes, 4,000 and 5,500 c.f.m. respectively.

The humidifier is shipped completely assembled, with all necessary auxiliaries for operation and control. The apparatus is stated to be entirely automatic.



Type I Unit Humidifier and Heater

New Oil Clarifier

Chemical engineers who are concerned with high pressure compression equipment as well as those whose plants are powered with Diesel engines, will be interested in a new horizontal type De Laval oil clarifier. The new unit is known as the 17-H machine and is rated at 17 to 18 g.p.h. The power required for its operation is 300 watts. It consists of a base upon which is mounted a small motor, belt connected to a horizontal bowl of the usual De Laval disk construction. Water and dirt removed from the oil are retained in the bowl which ordinarily requires cleaning two or three times per week.



Type 17-H Horizontal Oil Clarifier

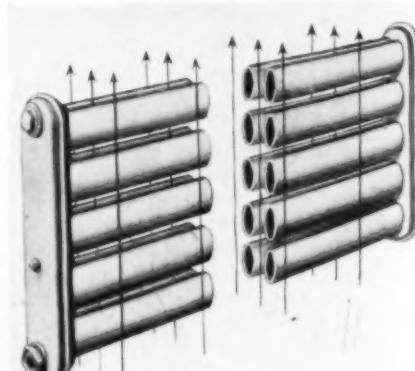
A small gear pump mounted on the unit and connected to the same motor controls the oil circulation from the lubricating system of the compressor or engine running with the clarifier.

It is claimed that the horizontal clarifier, designed as it is to operate continuously, results not only in a saving of oil but also in an improvement in lubricating efficiency. It is also stated that for this reason the new machine is more economical to install and operate than a batch system of oil purification.

High Convection Radiator

The accompanying illustration shows a new form of the Shaw-Perkins oval tube radiator. This is known as the High Convection type and consists of two parallel rows of oval tubes welded at both ends into vertical headers. The material used is commercially pure iron fashioned with all-welded construction, eliminating all mechanical joints.

The new radiator is said to permit positive temperature control due to its ability to heat and cool quickly. It is recommended for the heating of dry rooms and drying equipment, as well as factory buildings. The stream-line shape of the tubes permits easy convection and presents a large portion of the tube's external surface against the air currents.



Showing the Principle of the High Convection Radiator

Elevator Safety Lock

For large elevators, inclined bucket carriers, belt conveyors and similar equipment where the load on an incline or vertical lift would cause a backward run of the equipment if power were interrupted, the Jeffrey Manufacturing Company, Columbus, Ohio, has developed a silent ratchet safety lock. The drawing shows how one of the six pawls grouped around the ratchet is always in position to grip a ratchet tooth. The housing itself is bolted to the counter-shaft and turns with it when the power is on. The maximum backward motion possible for the ratchet is no more than one-third the distance between the teeth.



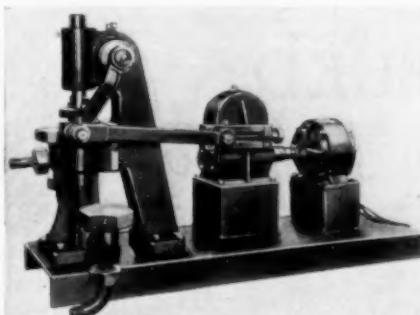
The ratchet itself is stationary and is secured by an arm to a spring attachment which takes the jar out of the operation of the mechanism when the load falls back on the pawl. The safety lock can be installed on apparatus now in use as well as on new equipment.

Duplex Drum Washer

A duplex drum washer is now being manufactured by the Eureka Machine Company, 2602 Vega Ave., Cleveland, Ohio. It consists of a mechanism into which two 50 or 55 gal. drums may be clamped to receive a rotary and an end-over-end motion. Any desired cutting solution, assisted if necessary by placing a chain in the drums, may be used. The height of the drum turn-tables is such that one man is able to load the washer. Power requirement is cut to 1 to 2 hp. through the use of anti-friction bearings and a speed of not over 20 r.p.m.

Proportioning Pump

The new type G proportioning pump made by the Hills-McCanna Co., Chicago, Ill., is shown herewith. It is simply constructed and driven by a rack and pinion with a guided plunger. There is said to be no possibility of distortion under high pressure. The stroke adjustment as is clearly shown



Adjustable Proportioning Pump for High Pressures

in the illustration is easily made by means of a screw-regulated crank mounted on the speed reducer. With nine sizes available and plunger diameters from $\frac{1}{2}$ to 3 inches, capacities ranging between 0 to 0.1 g.p.m., and 0 to $2\frac{1}{2}$ g.p.m. are available. The pump is recommended for high pressure proportioning service with chemicals which are not corrosive to iron and steel.

Gasoline Locomotive

A new design in gasoline locomotives for handling cars and materials about the plant has been brought out by the H. K. Porter Company, Pittsburgh, Pa. One of the principal features of the new design is the suspension from the main frame, by leaf and coil springs, of the entire power plant and transmission system. The running gear is identical with that used on the Porter Steam Dinky and the main frame and bumpers are the same as those in the Porter Steel Works Locomotive.

Erratum. The address of the Griscom-Russell Company's New York office in the June issue of *Chem. & Met.* should be read as 285 Madison Avenue.

Manufacturers' Latest Publications

Leavitt Machine Co., Orange, Mass.—Catalog 23—"The Dexter Valve Reseating Machine," a 48-page booklet describing reseating machines for globe valves, gate valves and pump valves.

Boston Gear Works Sales Company, Norfolk Downs, Mass.—"Standardized Renold-Boston Chain 'Drives,'" data book and price list on many kinds of chain drives.

Yeomans Brothers Company, 1434 Dayton St., Chicago, Ill.—Leaflet AC-70—describing rotary high-speed direct-connected air compressors.

The Elliott Company, Jeannette, Pa.—Publications as follows: Bulletin H-3, "BP" turbines for mechanical drive; bulletin H-4, "CP" turbines for mechanical drive; bulletin H-5, "DP" turbines for mechanical drive; bulletin N-8, power plant deaerators; bulletin N-9, de-superheaters, cartridge type; bulletin S-8, double automatic triple-duty valves.

New Haven Sand Blast Company, New Haven, Conn.—Bulletin describing the New Haven dust arrester.

American Instrument Company, 1220 D St., N. W., Washington, D. C.—Bulletin 506—The "Aminco" opacity meter for testing the transparency of paper.

Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 156—Bearing construction used in Wagner motors.

General Electric Company, Schenectady, N. Y.—Publications as follows: GEA-90C, automatic station installations; GEA-457A, "900 Series" squirrel cage induction motors; GEA-714A, MD-400 d.c. mill motors; GEA-869, CR7006-D31 magnetic switch; GEA-994, travel carriage for automatic arc welders.

Sullivan Machinery Company, 30 Church St., New York—Bulletin 83-J—Sullivan angle compound compressors of capacities from 300 to 5,100 cu. ft. of air per min. are described and illustrated.

Pennsylvania Pump & Compressor Company, Easton, Pa.—Bulletin 140—describes a single stage, double-acting, multiple belt driven, semi-portable air compressor.

Carrier Engineering Corporation, Newark, N. J.—Bulletin 8—48 page pamphlet completely describing the principle and applications of the Gordon regenerative drier. Also "The Thermal Engineer" by W. H. Carrier, a paper presented before the American Society of Refrigerating Engineers.

Bakelite Corporation, 247 Park Ave., New York, N. Y.—Publications as follows: "Bakelite Laminated," a pamphlet devoted to a description of the properties, uses and methods for working laminated Bakelite; a directory of molders of Bakelite and Bakelite Laminated.

Link-Belt Company, Chicago, Ill.—Catalog 500—New 1088 page catalog and engineering data book with price list covering power transmission, elevating and conveying machinery.

Celite Products Company, Los Angeles, Calif.—Publications as follows: Bulletin 141, "Insulation of Breechings and Stacks"; Bulletin 219, Celite Filter Aids. Covers the theory and practice of filtration, using various types of filter-aids.

The Electric Controller & Mfg. Company, Cleveland, Ohio—Folder describing the type ZO starting switches.

Consolidated Products Company, 15 Park Row, New York, N. Y.—Folder covering list of available types of used crushing and drying machinery and auxiliary equipment.

Leeds & Northrup Company, Philadelphia, Pa.—Bulletin 763—Describes the Brooks deflection potentiometer.

E. Leitz, Inc., 60 East 10th St., New York, N. Y.—Pamphlet 1129—The Leitz universal chemical microscope.

International Nickel Company, 67 Wall St., New York, N. Y.—Publications as follows: Folder describing the increased strength of nickel iron castings; Bulletin 206, data on wear and machinability of cast iron; Bulletin 12, alloy steel for boiler construction.

Esterline-Angus Company, Indianapolis, Ind.—Mailing piece describing the use of graphic wattmeters.

Niagara Falls Smelting & Refining Corporation, Buffalo, N. Y.—Leaflet giving U. S. Navy specifications for non-ferrous alloys.

Boiler Engineering Company, Federal Trust Building, Newark, N. J.—Folder describing "Beco" baffle walls.

Hardinge Company, York, Pa.—Publications as follows: Bulletins AH 124 and 155, concerning, variously, Hardinge sand filters, conical mills and Ruggles-Cole driers.

Lincoln Electric Company, Cleveland, Ohio—Bulletin 206—Discussion of two different types of arc welding equipment, to wit, variable-voltage single operator, and constant-potential, multiple operator.

Reeves Pulley Company, Columbus, Ind.—Publications as follows: Catalog No. 88, 64 page book completely describing the new Reeves variable speed transmission in its various applications, together with auxiliary equipment. Engineering data is also included; Bulletin No. 88-A, price list for Reeves transmissions.

Semet-Solvay Company, 40 Rector St., New York, N. Y.—Booklet describing the various types and uses of Solvay protective paints.

Semet-Solvay Engineering Corporation, 40 Rector St., New York, N. Y.—Publications as follows: Bulletin 43, "Carbureted Water Gas," a booklet describing the Steere water gas machine and the Backrun process; also pamphlets 342, 343, 345 and 346, concerning various gas plant equipment.

The New Departure Mfg. Company, Bristol, Conn.—Booklet on the relations of ball bearings to the problem of "More and better production at less cost."

Connerville Blower Company, Connerville, Ind.—Bulletin 17-A—SF and SFH rotary positive blowers for large capacities and low and medium pressure or suction.

Signal Engineering & Mfg. Company, 154 West 14th St., New York, N. Y.—Price list of signaling devices and control equipment.

PATENTS ISSUED

June 5 to June 26, 1928

PAPER, PULP, GLASS AND SUGAR

Apparatus for Making Composition Boards or Sheets. George H. Ellis, St. Paul, Minn.—1,672,249.

Method of Pulping Wood. Francis G. Rawling, Knoxville, Tenn.—1,673,089.

Manufacture of Dextrose. Charles Ebert, Leonia, N. J.; William B. Newkirk, Riverside, Ill.; and Meyer Moskowitz, Spring Valley, N. Y., assignors to International Patents Development Company, Wilmington, Del.—1,673,187.

Art and Apparatus for Debarking Pulp Slabs. Redmon H. Pangborn, Tacoma, Wash., assignor of two-thirds to F. C. Brewer and R. H. Shaffer, Tacoma, Wash.—1,673,265.

Method and Apparatus for Forming Continuous Sheet Glass. Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio.—1,673,907.

Automatic Steam Control and Differential for Paper Machines. Cole Stickle, Indianapolis, Ind.—1,674,845.

Paper-Coating Machine. Clarence O. Thorne, Watervliet, Mich., assignor of one-half to Philip G. Baltz, Chicago, Ill.—1,675,066.

Process and Apparatus for the Continuout Manufacture of Plate Glass or Sheets of Glass. Charles Heuze, Avelais, Belgium.—1,675,217.

RUBBER, RAYON AND SYNTHETIC PLASTICS

Process of Manufacturing Rubber-Like Products. Willy O. Herrmann and Wolfram Haehnel, Munich, Germany, assignors to Consortium für Elektrochemische Industrie, Munich, German.—1,672,157.

Protective Covering for Aluminum Bodies and Process of Making Same. Walter C. Peterson, Detroit, Mich., assignor to Packard Motor Car Company, Detroit, Mich.—1,672,280.

Process of Manufacturing Vulcanized Rubber. William P. Ter Horst, Akron, Ohio, assignor to The Rubber Service Laboratories Company, Akron, Ohio.—1,672,548.

Nozzle for Spinning Artificial Threads. Helmut Hoffmann, Grunberg, Hermann Mark, Berlin-Dahlem, and Reginald Oliver Herzog, Berlin-Steglitz, Germany.—1,672,644.

Process and Apparatus for the Manufacture of Artificial Silk and Other Artificial Textile Products from Cellulose Solutions by the Dry or Evaporative Method. Samuel Isidor Vles and Martinus Petrus Antonius Bouman, Arnhem, Netherlands, assignors to Naamloze Venootschap Nederlandse Kunststijdefabriek, Arnhem, Netherlands.—1,672,665.

Artificial-Silk and Like Spinning Machine. James Lever Rushton, Bolton, England.—1,672,691.

Bucket Brake. Fred G. Kraft and Arthur E. Guenther, Buffalo, N. Y., assignors to Du Pont Rayon Company, Incorporated, Buffalo, N. Y.—1,672,817. For pot spinning of rayon.

Resinous Reaction Product of Urea and Formaldehyde. Felix Lauter, Philadelphia, Pa., assignor to Rohm & Haas Company.—1,672,848.

Laminated Product and Method of Making Same. Frazier Groff, Bloomfield, N. J., assignor to Bakelite Corporation, New York, N. Y.—1,673,239.

Process of Treating Rubber and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,673,550.

Cotton-Boll Puller. William A. Martin, Fort Worth, Tex., assignor of 50 per cent to James R. Nelson, Grandview, Tex. Filed Dec. 10, 1926. Serial No. 153,987. 4 Claims. (Cl.56-35.)—1,673,576.

Method of Treating Latex and the Products Obtained Therefrom. Willis A. Gib-

bons, Great Neck, and John McGavack, Jackson Heights, N. Y., assignors to United States Rubber Plantations, Incorporated, New York, N. Y.—1,673,672.

Process of Making Impregnated Fabrics. Sandford Brown, Montclair, N. J., assignor to Bakelite Corporation, New York, N. Y.—1,673,797. Phenol resin in colloidal suspension.

Vulcanization Accelerator. Harry O. Chute, New York, N. Y.—1,673,801.

Hardening Resinous Exudations. Elmer Anson Daniels, Berwyn, and Harry Stirling Snell, Chicago, Ill., assignors to Western Electric Company, Incorporated, New York, N. Y.—1,673,803-8.

Condensation of Urea and Formaldehyde Under Pressure. Alphonse Gams and Gustav Widmer, Basel, Switzerland, assignors to the Firm Society of Chemical Industry In Basle, Basel, Switzerland.—1,674,199.

Cellulose Compounds and Processes for Making Same. Leon Lillienfeld, Vienna, Austria.—1,674,401-5.

Method of Treating Rubber Stock. Henry R. Minor, Ossining, N. Y., assignor to General Carbonic Company, New York, N. Y.—1,675,124.

PETROLEUM REFINING AND PRODUCTS

Conversion of Hydrocarbons. Harald Nielsen, Muswell Hill, England, assignor of one-half to Bryan Laing, Hatfield, England.—1,672,081.

Process of Treating Shale or the Like. Henry D. Ryan, Denver, Colo.—1,672,231.

Process of Purifying Mineral Oils. Marvin L. Chappell, El Segundo, George J. Ziser, Los Angeles, and Ernest L. Moyer, Hermosa Beach, Calif., assignors, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,672,304.

Distillation of Oils With Catalysts. George L. Prichard and Herbert Henderson, Port Arthur, Tex., assignors to Gulf Refining Company, Pittsburgh, Pa.—1,672,339.

Coke-Extracting Mechanism for Vertical Retorts for the Distillation of Carbonaceous Materials. Frederick Joseph West and Ernest West, Manchester, England.—1,672,442.

Process and Apparatus for the Distillation and Cracking of Hydrocarbon Oils. Hermanus Johannis Jansen, Schiedam, Netherlands.—1,672,459.

Refining Oil. Joseph R. Neller, Pullman, Wash., and George M. Vance, Tulsa, Okla., assignors by mesne assignments, to The Texas Company, New York, N. Y.—1,672,621.

Pressure - Still Process. Charles B. Buerger, Pittsburgh, Pa., assignor to Gulf Refining Company, Pittsburgh, Pa.—1,672,801.

Fractionating Hydrocarbon. Warren K. Lewis, Newton, Mass., and Alfred A. Wells, Roselle Park, N. J., assignors to Standard Oil Development Company—1,672,849.

Process for Producing Demulsifying Agents for Refining Petroleum Oil. Edwin D. Gray, Richmond, Calif., assignor, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,673,045.

Process of Cracking Mineral Crude Oils. Henry Blumenberg, Jr., Moapa, Nev., assignor to A. M. Buley, Los Angeles, Calif.—1,673,491.

Art of Pumping Gasiform Fluids. Frank A. Howard, Elizabeth, N. J., assignor to Standard Oil Development Company—1,673,678.

Process for Separating Hydrocarbons. Cornelius B. Watson, Columbus, Ohio, assignor to The Pure Oil Company, Chicago, Ill.—1,673,854.

Sealing Construction for Tanks. John Kuhl, Oakland, Calif., assignor to Standard

Oil Company of California, San Francisco, Calif.—1,673,933-4.

Method of Purifying and Decolorizing Petroleum Hydrocarbons. Alfred Oberle, Oak Park, Ill., assignor of one-half to Thomas E. Scofield, Kansas City, Mo.—1,674,020.

Floating Roof for Oil Tanks. Clifton A. Glass, Kansas City, Mo.—1,674,038.

Floating-Deck Oil Tank. Charles R. Gallagher, Los Angeles, Calif., assignor to Universal Holding Company.—1,674,104.

Method of Treating Hydrocarbons. Luis de Florez, Boston, Mass., assignor to The Texas Company, New York, N. Y.—1,674,390.

Manufacture and Production of Oxygenated Products from Hydrocarbons or Oxidizable Derivatives of Hydrocarbons. William Augustus Caspari, London, England.—1,674,589.

Process for Treating Oils with Liquid Sulphur Dioxide. Wilhelm Hess, Berlin-Grosslichterfelde-West, Germany, assignor to Allgemeine Gesellschaft für Chemische Industrie m. b. H., Berlin-Schoneberg, Germany.—1,674,676.

Process of Separating the Neutral Oils in Tars, Tar Oils and Pitches from Acid Constituents. Herbert Wittek, Beuthen, Germany.—1,674,710.

Process for Refining and Stabilizing Hydrocarbons. Eugene Albert Prudhomme, Neuilly-sur-Seine, France, assignor to Societe Internationale des Procedes Prudhomme (S. I. P. P.), Paris, France.—1,674,796.

Process and Apparatus for Cracking Oil. William R. Howard, Washington, D. C., assignor to Universal Oil Products Company, Chicago, Ill.—1,674,827.

Process for Distilling Emulsified Oils. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,674,819.

COAL PROCESSING AND COMBUSTION

Process for Gas Making. Harold R. Berry, Brooklyn, N. Y.—1,672,052.

Production of Carbureted Water Gas. Charles W. Andrews, Duluth, Minn.—1,672,109.

Fuel-Distilling Apparatus. Frank E. Hobson and James F. Shelton, Bellingham, Wash.; said Hobson assignor to said Shelton.—1,672,860.

Method of Preparing Solid Fuels for Burning in Pulverized Form. Lee B. Green, Lakewood, Ohio, assignor to The Borden Company, Warren, Ohio.—1,673,114.

Means and Method for Conserving Heat Generated in Gas-Making Apparatus. Pierre Plantinga, Cleveland, Ohio; The Cleveland Trust Company executor of said Pierre Plantinga, deceased.—1,673,589.

Process of the Manufacture of Gas from Coal. Morris William Travers, Aldwych, London, and Frank William Clark, Lymne, England, assignors to Travers and Clark, Limited, Manchester, England.—1,674,000.

Apparatus for Forming Reconstructed Carbonaceous Material. Watson B. Rulon, Philadelphia, Pa.—1,674,129.

Process for Distilling Solid Carbonaceous Material. Milton J. Trumble, Los Angeles, Calif.—1,674,420.

Carbonaceous Fuel and Process of Making Same. Alfred Oberle, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,674,837.

Fuel Briquette and Method of Making Same. Hugh H. Hansard, Montreal, Quebec, Canada.—1,675,266.

Process of Continuously Distilling Carbonaceous Fuel. Walter Edwin Trent, Washington, D. C., assignor to Trent Process Corporation, New York, N. Y.—1,675,315.

Continuous Cube-Drying Machine. Louis L. Edmunds, Crockett, Calif.—1,675,260.

Process of Making Briquettes. Peter Jung, Berlin-Neukolin, Germany.—1,675,272.

ORGANIC PROCESSES

Camphoric Alkaloids and Process of Making Same. Walter Schoeller, Berlin-Westend, and Herbert Schotte, Berlin-Wilmersdorf, Germany, assignors to the Firm Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,672,000.

Method of Making Aromatic Nitriles. Isaac V. Giles, Elizabeth, N. J., assignor to American Cyanamid Company, New York, N. Y.—1,672,253.

Production of Dyestuff Emulsion and of Color Lake Therefrom. Carl Ernest Julius Goedecke, Manchester, England, assignor to Wilhelm Eberlein, Marple, England.—1,672,454.

Process for Making Acetone and Butyl Alcohol. George W. Freiberg, St. Louis, Mo.—1,672,487.

Process of Purifying Carbazole. Charles J. Thatcher, New York, N. Y.—1,672,630.

Process for the Continuous Purification of Raw Bisulphide of Carbon. Eberhard Legeler, Premnitz, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,672,498.

Process for the Preparation of Carbocyclic Ketones with More Than Nine Ring Members. Leopold Ruzicka, Geneva, Switzerland, assignor to The Firm: M. Naef & Co., Geneva, Switzerland.—1,673,093.

Nitrocellulose - Lacquer Composition. Charles L. Gabriel and Charles Bogin, Terre Haute, Ind., assignors to Commercial Solvents Corporation, Terre Haute, Ind.—1,673,111.

Process of Purifying Para-Nitraniline. Alfred Miller, Buffalo, N. Y., assignor to Tower Manufacturing Co., Inc.—1,673,154.

Method of Producing Cyanamide from Calcium Cyanamide. Harry C. Hetherington and Louis A. Pinck, Washington, D. C., assignors to Arthur B. Lamb, trustee.—1,673,820.

Method of Producing Carbon Black from Mixtures of Acetylene and Other Hydrocarbons. Leonard R. Churchill, Bayonne, N. J., assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,673,496.

Manufacture of Thiocarbazides of the Naphthalene Series. George Malcolm Dryson, Manchester, Frederick Alfred Mason, Blackley, Manchester, and Arnold Renshaw, Manchester, England, assignors to British Dyestuff Corporation Limited, Manchester, England.—1,673,498-9.

Process of Manufacturing Photographic Silver Halide Emulsions and Products Obtained Thereby. Otto Matthies, Dessau, Peter Wulff, Starnberg, and Walter Dieterle and Bruno Wendt, Dessau, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,673,522.

Process for Drying and Extracting Gases from Metallic Powders. Eugene Seyfferth, Berlin-Waldmannsstadt, Germany, assignor, by mesne assignments, to the Firm: Fulmit G. m. b. H., Mehlem-on-the-Rhine, Germany.—1,674,230.

Method of Making Calcium Cyanamide. George E. Cox, Niagara Falls, N. Y., assignor to American Cyanamid Company, New York, N. Y.—1,674,466.

Purification of Crude Aromatic Hydrocarbons. Alphonse O. Jaeger, Crafton, Pa., assignor to The Selden Company, Pittsburgh, Pa.—1,674,472. Activated charcoal.

Absorbent Catalyst. Albert Godel, Laguen, France, assignor to Societe de Recherches & d'Exploitations Petrollifères, Paris, France.—1,674,897.

Method of Producing Oxidation Products from Gaseous Hydrocarbons. Joseph Hidy James, Pittsburgh, Pa., assignor, by direct and mesne assignments, to Clarence P. Bvrnes, Pittsburgh, Pa., trustee.—1,675,029.

INORGANIC PROCESSES

Method of Making Alkali Cyanides. Charles P. Davis, Elizabeth, N. J., and Grenville B. Frost, Kingston, Ontario, Canada, assignors to American Cyanamid Company, New York, N. Y.—1,672,449.

Catalyst for the Production of Hydrogen. Hugo E. Heissler, Syracuse, N. Y., assignor to Atmospheric Nitrogen Corporation, Solvay, N. Y.—1,672,528.

Method of Making Gels. Ernest B. Miller and Gerald C. Connolly, Baltimore, Md., assignors to The Silica Gel Corporation, Baltimore, Md.—1,672,768.

Means for Desulphurizing Gases. Emil Rafler, Duisburg-on-the-Rhine, Germany, assignor of one-half to Wm. E. Leuchtenberg, New York.—1,672,778.

Producing Alumina Free from Iron. Heinrich Specketer, Griesheim-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,672,788.

Process of Chlorination. Sandford Brown, Montclair, N. J., assignor, by mesne assignments, to Halowax Corporation, New York, N. Y.—1,672,878.

Process of Producing Hydrogen. Roger Williams, Wilmington, Del., assignor to Lazote Inc., Wilmington, Del.—1,673,032.

Method for the Producing of Technical Pure Beryllium Respectively for Freeing Metallic Beryllium from Impurities. Hellmut Fischer, Berlin-Friedenau, Germany, assignor to Siemens & Halske Aktiengesellschaft, Siemensstadt, near Berlin, Germany.—1,673,043.

Method of Purification of Sodium Sulphate. Milton A. Purdy, Oakland, Calif., assignor of one-half to Pacific Distributing Corporation, San Francisco, Calif.—1,673,471.

Process for Making Anhydrous Aluminum Chloride. Niels C. Christensen, Salt Lake City, Utah.—1,673,495.

Method of Producing Hydrogen. Frans G. Liljenroth, Stockholm, Sweden, and Markus Larsson, Niagara Falls, N. Y., assignors, by direct and mesne assignments, to Phosphorus - Hydrogen Company.—1,673,691.

Process for Mining Sulphur. Wilson T. Lundy and Homer S. Burns, Freeport, Tex., assignors to The Freeport Sulphur Company, Freeport, Tex.—1,673,879.

Apparatus for the Synthetic Production of Ammonia from the Elements. Ivar Walfrid Cederberg, Berlin-Steglitz, Germany, assignor to Patent Verwertungs Aktiengesellschaft "Alpina," Societe Anonyme pour l'Exploitation des Brevets "Alpina," Patents Exploitation Company "Alpina" Ltd., Basel, Switzerland.—1,673,966.

Copies of Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Photostatic copies of foreign patents may be obtained at the same address, prices on application.

Recovery of Soluble Salts from Natural Brines or the Like. Clinton E. Dolbear, Los Angeles, Calif.—1,673,969.

Process of Purifying Barium Carbonate. Johann Eduard Marwedel and Joseph Looser, Honningen-on-the-Rhine, Germany, assignors to the Firm Rhenania-Kunheim Verein Chemischer Fabriken A. G., Berlin, Germany.—1,673,985.

Production of Alkali Metal Nitrates. Wilhelm Wild and Christoph Beck, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,674,077.

Process for Recovery of Sodium Bicarbonate from Brines. Walter A. Kuhnert, Los Angeles, Calif.—1,674,474.

Separation of Ingredients from an Alkaline Mixture Containing Oxsalt of Arsenic and/or Oxsalt of Tin. Henry Harris, London, England.—1,674,642.

Refractory Article and Material and Method of Making the Same. Grant S. Diamond, Buffalo, N. Y., assignor to The Electric Refractories Corp., Buffalo, N. Y.—1,674,961.

Deposition of Thorium from its Vaporable Compounds. John Wesley Marden, East Orange, and Thomas Philip Thomas and John Edward Conley, Bloomfield, N. J.—1,675,120.

Process for the Production of Alumina. Charles McCombie Brown, Toronto, Ontario, Canada.—1,675,157.

CHEMICAL ENGINEERING PROCESSES AND EQUIPMENT

Stirring Device for Driers. Harlan W. How, Buffalo, N. Y., assignor to Buffalo Foundry & Machine Company, Buffalo, N. Y.—1,672,218.

Catalyst Carrier. Charles R. Downs, Cliffside, N. J.—1,672,308. Partial oxidation of benzene.

Producing Corrosion-Resistant Surfaces on Metals. Frederick M. Becket, New York, N. Y., assignor to Electro-Metallurgical Company.—1,672,444.

Process of and Material for Treating Sewage and Industrial Wastes. John T. Travers, Columbus, Ohio, assignor, by direct and mesne assignments, to The Travers-Lewis Process Corporation, Columbus, Ohio.—1,672,583-7.

Soap Stabilization. Jesse R. Powell, Chi-

cago, Ill., assignor to Armour & Company, Chicago, Ill.—1,672,657.

Electric Cut-Out for Stills and the Like. Lester F. Boss, Woods Hole, Mass.—1,672,800.

Conveyer. Gustave Bluemel, Chicago, Ill., assignor of one-half to Drying Systems, Inc., Chicago, Ill.—1,672,843.

Distillation of Liquid Mixtures. James P. Fisher, Bartlesville, Okla., assignor, by mesne assignments, to Heat Treating Company, New York, N. Y.—1,672,978.

Rate of Flow Controller. Frederick N. Connet and George T. Huxford, Providence, R. I., assignors to Builders Iron Foundry, Providence, R. I.—1,673,041.

Apparatus for Dehydrating Liquids. Samuel M. Dick, Minneapolis, Minn., assignor to International Dry Milk Company, Minneapolis, Minn.—1,673,066.

Vacuum Mixing Machine. Evarts G. Loomis, Newark, N. J.—1,673,085.

Refractory Material. Joseph G. Donaldson and Henry L. Coles, Hamilton, Ohio, assignors to Guardian Metals Company, Hamilton, Ohio.—1,673,106-7.

Drying Machine. Hubert A. Hatfield, New Glasgow, Nova Scotia, Canada.—1,673,241.

Rectifying Apparatus. William A. Peters, Jr., Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,673,374.

Drying Apparatus. Wilson L. McLaughlin, Des Moines, Iowa.—1,673,464.

Pulverizing Machine. Wilson L. McLaughlin and Herrold L. McLaughlin, Des Moines, Iowa.—1,673,465.

Pulverizing Mill. William M. Barker, Canton, and Louis C. Bonnot, Louisville, Ohio.—1,673,483.

Electric Furnace. Ernst Wirz, Baden, Switzerland, assignor to Aktiengesellschaft A. G. Brown, Boerl & Cie., Baden, Switzerland.—1,673,543.

Apparatus and Method for Gaseous Reactions. James M. Weed, Scotia, N. Y., assignor to General Electric Company.—1,673,654.

Concentrator. Albert H. Stebbins, Los Angeles, Calif.—1,673,849.

Air Classifier. Albert H. Stebbins, Los Angeles, Calif.—1,673,848.

Regulation of Flow of Fluids. Kurt Huesener, Pittsburgh, Pa.; Julie Huesener, executrix of said Kurt Huesener, deceased.—1,673,872.

Process for the Purification of Gases. Herbert J. Kruse, Clarendon, Va., and Harry C. Hetherington and Alfred T. Larson, Washington, D. C., assignors to Arthur B. Lamb, trustee.—1,673,877.

Bubble Cap for Gas and Liquid Contact Apparatus. Clive M. Alexander, Waxahachie, Tex.—1,673,895.

Apparatus for Analyzing Gas. Frank J. East, Brooklyn, N. Y., assignor to Charles J. Tagliabue Mfg. Co., Brooklyn, N. Y.—1,673,898.

Heat Exchanger. Max Mauran, Niagara Falls, N. Y., assignor to The Matheson Alkali Works, Inc., New York, N. Y.—1,673,918.

Electrically-Operated Valve for Controlling the Flow of Liquids or Gases. Charles Wight Snyder, Los Angeles, Calif.—1,673,923.

Dehydrator Having Rotatable Electrode. William O. Eddy, Long Beach, Calif., assignor to Petroleum Rectifying Company of California, Los Angeles, Calif.—1,674,242.

Gas Compressor. Stephanie Imhoff-Papáckova, Basel, Switzerland.—1,674,374.

Automatic Water Softener. Charles P. Eisenhauer, Dayton, Ohio, assignor to The Duro Company, Dayton, Ohio.—1,674,717.

Leer Conveyer and Driving Mechanism. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn.—1,674,794.

Tunnel-Kiln Car and Method of Loading Ware Thereon. George D. Morris, New Castle, Pa., assignor to New Castle Refractories Company, New Castle, Pa.—1,674,838.

Beater-Engine Roll. Arthur M. McPhillips, Beloit, Wis.—1,674,911.

Pump. Walter T. Smith, Galveston, Tex.—1,675,199-200.

Drum Cooler or Drier. Stuart P. Miller, Philadelphia, Pa., assignor to The Barrett Company.—1,675,274.

NEWS of the Industry

McGraw-Hill Will Issue Publication For Food Industries

New Monthly Will Be Devoted to Plant
Operation and Production Methods

A NEW monthly publication, to be devoted to the food industries, will be published by the McGraw-Hill Publishing Company, starting with the first of October. The new paper will be called *Food Industries*, according to an announcement just made by the executive committee of the company.

The publication will serve its readers by covering for them the technology of manufacturing food products, methods of food production, materials used in food processing and packing, materials of construction for equipment, handling of raw materials and finished products, research on food preservation and preparation, bacteriology, sanitation, improvement of processes and reduction of costs. In general, the paper will be devoted editorially to plant operation and production methods in the food industries.

EDITORIAL direction of *Food Industries* will be under Dr. H. C. Parmelee, editor of *Chemical and Metallurgical Engineering* and vice-chairman of the editorial board of the McGraw-Hill publications, who, however, will continue in those executive positions. Associated with him on the editorial staff will be Robert Gordon Gould, former owner and publisher of the *American Food Journal* and later vice-president and general manager of the *National Provisioner*. Dr. Paul D. V. Manning and R. S. McBride, both members of *Chem. & Met.*'s editorial staff, will represent *Food Industries* on the Pacific Coast and in Washington, D. C., respectively.

M. A. Williamson, business manager of *Chemical & Metallurgical Engineering*, will be business manager of the new monthly, although he will continue in his present connection.

"General divisions of the food industry," the announcement says, "include dairy products, canning and preserving, confectionery and ice cream, meat packing, flour and grain mill products and baking and bakery products. In addition, there is a miscellaneous group of food industries, including condiments, nuts and rice, flavoring extracts, yeasts, beverages, ice and sugar."

"These industries are perhaps more related than any other both by the nature of the products and secondly, by the common connection of fundamental manufacturing operations as heat technology, mixing and kneading, grinding, sanitation, conditioning, that is seasoning, etc. They have all one primary objective and that is the supplying of food. They are all working under varying degrees of pressure due to changing taste of public, stricter legal supervision and keener competition from every angle. To give some idea of the size of the field, according to the U. S. Bureau of Census figures for 1925, the food industries turned out \$10,496,564,490.00 worth of products. Of the 48,189 plants 10,511 produced slightly over 89.26 per cent of the total value of the products."

Finance Body for Chemical Interests of Europe

ACCORDING to a special cable from Paris to the *New York Times* the German, French and Swiss chemical interests that form the major part of the European chemical trust are considering the formation of a Continental corporation to inquire into all new processes offered on the market and to assist struggling chemical companies throughout Europe. A meeting of the chief chemical concerns of the three nations was held recently in Basle. It is believed in Paris that the proposed body would operate to offset the British-American Finance Corporation.

The chemical trust, it is thought in Paris, is viewing the possible activities of the British-American group as a danger to its continental expansion and is seriously discussing means to meet the situation. If the Basle meeting proves fruitful then the Continental body would be established with an aim similar to that of the British-American corporation.

Furthermore, new processes, patents, etc., as they came upon the market and were approved by the Continental group, would be exploited for the benefit of the three countries concerned.

Important Freight Rate Suspension Ordered

DOUBLING the freight rate on returned empty gas cylinders, acid carboys, cement bags, and other carriers and containers is prevented by the decision of the suspension board of the Interstate Commerce Commission in the Southwestern consolidated railway freight case. The carriers in that area had proposed the cancellation of the former rate, which provided one-half of Class 4 rates on returned empties, and had proposed full Class 4 rates. This change was proposed as a part of the effort being made to eliminate commodity rates and special exceptions to class rates in this area. The proposed increase was to have taken effect on July 8, but on the day preceding this the suspension was ordered and the effective date postponed until some time in 1929, to permit investigation of the reasonableness of the new charges.

This is not the only rate case in which increases have recently been proposed for returned empty containers. All of this type of changes which would result in substantial increase in delivery charges on many chemicals have been opposed before the Commission by representatives of Compressed Gas Manufacturers' Association, Chlorine Institute, Manufacturing Chemists' Association, and other industry groups.

Institute of Chemistry to Open July 23

CHEMISTS from different sections of the United States will assemble at Evanston, Ill., on July 23, to attend the opening of the second annual Institute of Chemistry at Northwestern University. Farm relief, public health, national defense, petroleum, rubber, motion pictures, life processes, sanitation, public water supply, food and clothing, leather, the world nitrogen situation, chemical education, chemistry in industry, and matter and energy are among the topics to be discussed by scientists of America and Europe at sessions lasting one month.

Sir James Colquhoun Irvine, Principal of St. Andrews University, Scotland, and a world authority in the chemistry of sugar, is among the foreign scientists scheduled to speak. Another is Dr. Gulbrand Lunde of the University of Oslo, Norway.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

BANKS AND investment houses are taking a very active interest in the chemical industry. There is abundant evidence that they are trying to learn all they can of the business which in a decade has risen from an inconspicuous rank to fourth place among American industries.

The interest of financiers is not simply for the purpose of learning enough to enable them to make loans wisely. It is apparent that they see in the 9,000 separate corporate organizations engaged in chemical or allied activities a particularly fertile field in which they can engineer consolidations. This process has been productive of great economies in other industries. With a few notable exceptions this trend in modern business has not been extended to the chemical industry. The possibilities in that direction seem to be behind the unusual interest which financial houses are showing in the chemical industry just at this time. Many of the larger institutions are retaining chemists as advisory members of their regular staffs.

WITH the idea of furthering standardization and simplification of glass containers a joint committee has been appointed by the interests principally concerned. Each of the following organizations is to appoint one voting delegate and two associate delegates who are to confer with officials of the Department of Commerce on August 6: Synthetic Organic Chemical Manufacturers' Association; Glass Container Association of America; American Association of Colleges of Pharmacy; The Proprietary Association; American Drug Manufacturers' Association; The Package Medicine Association; American Pharmaceutical Association; National Wholesale Druggists Association; American Pharmaceutical Manufacturers' Association; National Drug Trade Conference; Association of Dairy, Food and Drug Officials; National Conference of Pharmaceutical Research; Druggists' Research Bureau; National Association of Retail Druggists; Federal Wholesale Druggists' Association; National Association of Boards of Pharmacy.

Efforts have been made for several years to reduce the variety of bottles. Some progress has been made within the industry, but the meeting in Washington July 6, of representatives of the above organizations, was the first organized effort to co-operate with the Department of Commerce to that end. All in attendance at the meeting agreed that there is at present excess variety in types, sizes and capacities of glass containers. All are anxious to secure an understanding which will better the

situation. It was pointed out on behalf of the manufacturers, however, that the making of new molds and the changing of manufacturing practice is an expensive undertaking. There seemed to be a decided preference for square bottles because of the economy of shelf space made possible and in the floor space required for stock. There is a strong preference among retail druggists for metal caps on liquid containers.

Canadian authorities attach significance to the discovery of potash salts in West Morland County, New Brunswick. The potash was associated with rock salt at a depth of 1,500 feet. There has been a revival of interest in potash development in Spain. A strong company is about to be formed, according to reports reaching Washington, to conduct operations near Cazalla in the province of Sevilla.

PLANS are going forward in Holland for the establishment of the government synthetic ammonia plant at the state coal mine at Lutterdae in the Province of Limburg. Estimates which have been submitted for the plant exceed \$5,000,000. The plan, however, is subject to approval by the Parliament, but it is believed that it will be forthcoming.

The new schedule of prices issued June 27 by the German Nitrogen Syndicate shows only minor changes. This means that the Chilean government will not be called upon at this time to pay the bonus announced in its circular of May 22, in which members of the Nitrate Producers' Association are to be paid a bonus equivalent to any reduction that may be made by the Stickstoff syndicate. The agreement is to apply to all exports of nitrogen for consumption during the nitrate year of 1928 and 1929. This tender of government aid is not to apply on exports after April 30, 1929. In its agreement with the producers the government's circular states that if the reduction be five pfennig for the unit of nitrogen, considering that sulphate of ammonia has 21 per cent of nitrogen, there should be a reduction of 105 pfennig, which in round numbers would be represented by one shilling per metric quintal, or ten shillings per ton. In such a case the government would pay the producer the ten shillings per ton, but the bonus "shall be delivered by the seller to the buyer at the time of the receipt of the nitrate."

BY FORMING a combined research bureau, German, Swiss, and French chemical producers will place themselves in a position to compete with the recently formed British and American Finance Corporation, according to re-

ports received by the Chemical Division from French chemical interests. The British and American Finance Corporation was formed jointly by the Chase National Bank of New York and the Imperial Chemical Industries, Ltd., of London.

French, German, and Swiss chemical producers, the Department of Commerce has been advised, met at Basel Switzerland on July 1, to consider the matter of forming this proposed research bureau which it is understood would be for the general purpose of testing new chemical processes with an ultimate view of obtaining rights for the three countries represented. It is believed that this conference at Basel explains the rumors emanating from European sources to the effect that a 20,000,000 franc (Swiss) combination was being formed to co-operate with the German A. G.

ABANDONMENT of the rubber control by the British has caused other nations that are interfering with the free movement of raw materials to take more note of where they are heading, advices reaching Washington indicate. In practically every country where such policies are followed there is a division of opinion as to the wisdom of schemes that interfere with the free flow of raw materials. The repeal of the Stevenson Act has aroused the opposition, both within and without the countries resorting to such methods, with the result that the constituted authorities are becoming uneasy and are taking more note of where their policies are leading them.

The policy of the Bolivian government in levying an ever increasing export duty on tin and the actual participation of the government in the profits of producers is having a most decided effect on the production of tin from a world standpoint. Such a policy is retarding the development of marginal producers and is coming in for renewed criticism.

In Mexico the various laws governing employment of labor and its participation in profits, and limiting the time of possession, also the attempt to force local capital (practically non-existent) to participate in foreign development companies is retarding mining and prospecting for oil and is giving rise to a demand for a change.

The various enactments in Brazil in reference to export duty on manganese deprived that government for a part of 1927 of the major portion of its revenue derived from this source. The policy of Brazil in reference to the iron deposits is declared to have retarded their development.

The Chemical Division recently completed a survey of the iodine situation. Similar surveys already have been made of nitrogen, camphor and menthol. One of the significant facts brought out is that competition for iodine is developing, not only in the form of substitutes but from new sources of production. The increasing use of seaweed abroad as a source of adhesives is resulting in the incidental recovery of iodine.

British Chemical Trades Affected By Unemployment

Improvement in Basic Industries Probable—
Sir Alfred Mond Enters Peerage

From Our London Correspondent

ALTHOUGH employment in the chemical industry generally is quite good, the effect of unemployment on chemical trades, although there is a lag in its effect, may render it opportune to consider broadly the unemployment problem of this country. For many months the number of unemployed has averaged over 1,000,000 insured workers or somewhat over 10 per cent. Towards this total the mining industries contribute about one-fifth, the industries which make and use metals another fifth, the textile, building, transport and distributing trades another fifth, leaving only about one-fifth for the remainder. It is therefore clear that a revival in some of the basic industries could easily operate to reduce unemployment to the prewar average of about 5 per cent. Although the unemployment insurance system already is paying its way, yet the contributions asked from employers, employed and the State, are unduly heavy and any reduction in the volume of unemployment would represent a lightening of the burden. It is not without interest to know that the burden of unemployment is twice as heavy among men as among women, and that for every three insured men in industry there is one insured woman worker. During the next few years the number of men entering industry will, owing to war and other effects, be actually less than the number leaving industry owing to natural causes. This fact and the present rather encouraging outlook indicates that although the problem of unemployment can only be solved gradually, there seems no reason to doubt that this country has passed the worst period and that the unemployment figures, which have such a material bearing upon the chemical trade of this country will gradually improve.

Sir Alfred Mond has now received the Peerage, which it was known for some time he would be given in recognition of his eminent services. In spite of the many suggestions, humorous and otherwise, which were made to him, the title of Lord Melchett was selected as being the name of his country home. Perhaps the most amusing suggestion, hardly a polite one, was that of Lord Richmond. The annual report of Lord Melchett's great undertaking—Imperial Chemical Industries—was very cheerful reading and the position is likely to be even stronger two years hence than it is today. To provide the large funds which will, in the future be required for extensions at Billingham and elsewhere, a new capital issue has just been made by the Finance Company of Great Britain and America, which thus earns its first profit by underwriting. Lord Weir has joined the board of Imperial Chemical Industries and by the end

of the year it is quite probable that the organization will get well into its stride and that decisions and announcements of a far reaching character will be made. Of course the principal sources of revenue for dividend purposes are at present the alkali and explosives industries and the balance sheet has been materially helped by the profits realized on capital account from investments in other undertakings, such as the General Motors Corporation.

THE future program of I.C.I. in regard to fertilizers and in regard to production of oil from coal continues to receive attention in the technical press and in chemical circles. Apart from the particulars made public in I.C.I.'s annual report, considerable interest attaches to the annual report of the British Sulphate of Ammonia Federation, Ltd., of which Nitram Limited, a subsidiary of I.C.I., is now the sole selling agent on a non-profits basis. Nitram also, is the selling agent for all other forms of nitrogen for agricultural consumption produced by Synthetic Ammonia & Nitrates, Ltd., and all members of the federation contribute a maximum of 3s. per ton produced towards the combined cost of administration and propaganda. In some respects the report is rather pessimistic inasmuch as it warns those who are about to embark on the manufacture of synthetic nitrogen that they must be prepared to face the level of price which is likely to be reached in an endeavor to quadruple the average annual increment of fertilizer consumption during the past four years. This statement is of course supported by the necessary statistics and by the fact that sulphate of ammonia prices have fallen during the year by about 26 per cent. The total annual consumption of nitrogen in the world is about 1,300,000 tons and it is anticipated that if the synthetic works now in course of construction are completed according to plan, the annual production of fixed nitrogen in the world will have increased to about 2,000,000 tons by 1930/31. It is evident, therefore, that although every effort will be made to maintain prices, a fall in values is almost inevitable and, therefore, only the most economical processes based on minimum hydrogen and other costs are likely to survive.

THE latest recruit to the Splinterless Glass field is Acetex Safety Glass Limited, with a capital of about \$1,000,000. It is claimed for Acetex glass that it will not splinter, does not discolor, is impervious to moisture, contains no inflammable adhesives and can be cut to any required size without difficulty. The main basis of the com-

pany's process appears to lie in a special method of pressing which practically eliminates breakage and in a formula which is the subject of a patent application by G. E. Heyl. In particular, this company is proposing to cater to the large consuming public on a low price basis of \$1.75 and upwards per square foot, and it is stated that the processes do not infringe and definitely differ from the prior patent specifications under which other manufacturers are or will be working. It seems very probable that before long there will be litigation in this field, which is closely allied to the acetate silk industry and presumably attempts will be made in America by most of these companies to dispose of their rights, pending or granted.

The borax position is in a peculiar state at the present time owing to the sudden fall in prices which is probably partly due to the Italian producers breaking away from the convention.

Merger of McGraw-Hill and Shaw Companies

MERGER of the McGraw-Hill Publishing Company and the A. W. Shaw Company of Chicago was announced June 29.

The Shaw organization publishes *The Magazine of Business, System and Industrial Distributor and Salesman*. The two companies have had a close relationship since last fall when they jointly formed the McGraw-Shaw Company.

A. W. Shaw will continue as chairman of the board and James H. McGraw will become president of the A. W. Shaw Company. Mr. Shaw will also become a director of the McGraw-Hill Publishing Company, Inc., and will continue as president of the McGraw-Shaw Company. Wheeler Sammons will become a director and member of the executive committee of the McGraw-Hill Publishing Company and senior vice-president and general manager of the A. W. Shaw division of the business, which will be known as the "A. W. Shaw Company, a division of the McGraw-Hill Publishing Company, Inc." The McGraw-Shaw Company will also be operated as a division of the McGraw-Hill Publishing Company.

Two reasons for the merger are stressed by the officers of the merging companies. The magazines of the two organizations are complementary in character. The Shaw papers cover business broadly, giving the business man an understanding of what is going on in all branches of trade, industry and finance. Their service is extensive in character. The McGraw-Hill service, on the other hand, is intensive. Its magazines give a highly specialized service to given major industries and to related industrial groups. Thus the consolidated companies serve the business man in both his general and special business interests. The second reason is the very evident economy and increased effectiveness of consolidated operation.

French Chemical Industries Show Large Net Earnings

Tariff Protection Aids Production and Fall of the Franc Increases Exports

From Our Paris Correspondent

LACQUER and varnish manufacture have become very important in France owing to the increasing production of French motor cars. Many of the lacquer and varnish companies are merely branches of American firms and receive their supplies of nitrocellulose from the United States.

Among the better known manufacturers of solvents and plastics is the Distillerie des Deux-Sèvres at Melle. This firm produces, by the fermentation process, acetone and butylic solvents in large quantities. It controls the azeotropic process for the manufacture of absolutely pure alcohol, a process recently introduced in Hungary, Germany and shortly to be introduced in Panama and Cuba. In Germany the process came into competition with the Merck process. With the Merck process alcohol becomes dehydrated by azeotropic means under a pressure of 10 atmospheres. Experiments with this process were made by the German monopoly at Adlershof near Berlin. The Merck company also preconizes another dehydrating process by anhydrous lime under pressure. This process probably will be bought by the German monopoly. In the lac and varnish industries the following new solvents are recommended by the firm of Lambiotte Brothers: methylal, diacetone-alcohol and oxyde of mesityl.

Methylal is particularly used as a solvent for nitrocellulose resins, gums and fats; diacetone-alcohol for cellulose acetate and nitrocellulose; oxyde of mesityl for nitrocellulose as well as synthetic formophenol resins.

The Ketol Sty. which produces its ketol by the distillation of butyrate of lime, starting from saw-dust, has developed the use of this material as a solvent in the cellulose varnish industry. Ketol itself is made by mixing ketons coming from methylethylketone to kaprone in which butyron is predominates; by fractionated distillation ketons boiling between 80 deg. to 160 deg. may be obtained which can be used for the cellulose varnish industry. A few special fractions of this distillation enable one to produce 40 per cent colloidion solutions, fluid enough to be used both in the varnished leather industry and in artificial leathers and similar products.

THE Etablissements Poulenc and the Société Chimique des Usines Du Rhône have amalgamated. The last named firm increases its capital from 27 to 38 million francs, the new 90,000 hundred francs shares thus made, going to the Poulenc shareholders. A new increase of capital of 50 million francs has already been voted. We may add that the new company made, in 1927, a

clear profit of 16½ million francs and prospects look bright.

The Etablissements Kuhlmann showed, in 1927, a net profit of 34 million francs on a working capital of 200 million francs. A recent meeting of shareholders voted an increase of capital, to 250 million francs and ultimately to 300 million francs.

IN ORDER to provide the Borvisk Rayon Co. with the necessary bisulphide of carbon the Kuhlmann Co. and Progil Co. have organized a new joint society, the Kuhlmann-Progil Co., with a working capital of 5 million francs. This firm will have its works at Nevers and maybe at Valenciennes, as there are no manufacturers of bisulphide of carbon in the North of France. As a matter of fact French production of bisulphide of carbon cannot supply present demands and large quantities come from Belgian factories which supply the rayon industries of Calais, Valenciennes and Givet. To make one kilo of rayon, half a kilo of bisulphide of carbon is necessary which means that France alone needs a yearly supply of about 4,500 tons of this chemical. The Kuhlmann Co. has entered closer business relations with the Compagnie des Produits Chimiques Coignet. This company is well known as a manufacturer of phosphorus and phosphates. It is obviously in view of the manufacture of concentrated fertilizing matters that this closer contact has been made. The Kuhlmann Co. has also started the manufacture of phosphate of ammonia in the affiliated factories of Brignoud. These works already produce 3,000 tons of nitric fertilizers yearly; they will therefore be the first to manufacture concentrated fertilizers in France.

In order to supply all demands from agricultural circles this new firm also contemplates the manufacture of another kind of concentrated fertilizer, based on nitrogen, potash and phosphoric acid. The above-mentioned transformation of the phosphate industry when fully realized would bring a notable decrease in the use of sulphuric acid, three-fourths of which is now used for the making of superphosphates. This is probably one of the chief reasons which draw the mineral industries attention towards the rayon industry, a large consumer of sulphuric acid. As an instance of this we might mention the Société des Produits Chimiques Bozel-Maletra which promoted the new rayon firm, the Setyle Française, a company with a working capital of 25 million francs closely affiliated with the Italian company, the Setyl Italiana. The Kuhlmann company has drawn together all producers of coloring matters in

France, a fact clearly shown by the admission in the Société des Matières Colorantes de Saint-Denis of a directorship and general management of several Kuhlmann trustees.

THE Société des Matières Colorantes de Saint-Denis realized a clear profit of 8 million francs with a working capital of 40 million francs. It has common interests and joint trustees with the well known firm of Saint-Gobain. This firm, one of the oldest and richest companies of France, whose origin goes as far back as the XVII century, showed, in 1927, a profit of 44 million francs on a working capital of 161 million francs. This capital will shortly be raised to 205 million francs. This general outlook on the business activity of the French chemical industry would not be complete if we did not quote the two following companies: the Société de l'Air Liquide and the Compagnie d'Alès Froges Camargue. The former company shows a yearly profit of 42 million francs and the latter company a yearly profit of 47 million francs.

As may be gathered by the above figures the French chemical industries are in a strong financial condition. This favorable position is partly due to the constant development of the chemical industries in France since the war and also partly to the high custom tariff protecting it against foreign competition. Moreover the fall of the franc has opened to France many world markets formerly closed. Since the war French exports have increased enormously and most probably doubled in quantity.

Report Submitted on Cement Dust Hazards

A COMPREHENSIVE investigation regarding the health of workers in the cement industry has been reported on by the U. S. Public Health Service. The results of the investigation indicate that the high calcium dusts encountered in Portland cement manufacture do not predispose workers to tuberculosis or pneumonia, but seem to produce an abnormal number of attacks of the diseases of the upper respiratory tract, such as colds, bronchitis, tonsilitis, and some varieties of grippe. It is also concluded that limestone dust is even more deleterious in this respect than cement dust. A full report on this investigation is available in the form of Bulletin 176 of the U. S. Public Health Service.

China Wood Oil Exporters Form Association

All exporters of wood oil to the United States at Hankow and 90 per cent of the other wood oil dealers located there have formed a wood oil exporters' association, according to a cable from the consul general at Hankow.

Object of the association is said to be the safeguarding and promotion of the wood oil interest of its members. Prospects are that all exporters of wood oil will soon join the association.

Technical Development in Germany Concentrated on Liquid Fuels

Papers on Processing of Coal Predominated at Annual Meeting of German Chemists

From Our Berlin Correspondent

MOST RECENT technical development in Germany is now concentrated on liquid fuels rather than dye-stuffs and pharmaceuticals, notwithstanding the fact that significant developments have been made in the latter field. This was emphasized in June at the general meeting of the Society of German Chemists, held at Dresden, in the award of the Liebig Medal to Dr. Fr. Bergius, indicating the importance attached to the developments in the liquefaction of coal. Bergius reported not only on the development of this discovery but also on his new process for the conversion of wood into cattle food. Willstätter found that hydrochloric acid changes wood cellulose into digestible carbohydrates, and in this process it is of peculiar technological interest that the hydrochloric acid is afterward recovered from the resultant sugars by means of warm mineral oils.

A. Mittasch, who organized the catalytic research activities of the I.G., spoke of the characteristic properties of ferric carbonyl, $\text{Fe}(\text{CO})_5$, and of its method of production. Under the name of "Motalin" this product is used as an anti-knock compound. By the application of short-length rays it yields $\text{Fe}(\text{CO})_5$, a procedure adaptable as a new method for making photographic copies. A remarkable substance called "carbonyl iron" is formed when ferric carbonyl is heated under special conditions. It is a very pure iron powder characterized by high permeability, low hysteresis, and low eddy-current losses, making advantageous its use in magnetic cores and Pupin coils. Its high purity and extreme degree of subdivision, however, make it especially adapted for catalytic uses: thus, when touched by a glowing match, it burns with an intense flame.

ACCORDING to Dr. C. Wulff of the Institute of Coal Research at Breslau, highly efficient lubricants may be synthesized from the olefines (ethylene, propylene, butylene) found in industrial waste gases when these are brought into reaction with benzene and its homologs from tar-extraction, in the presence of the catalytic halides of aluminum, iron or boron at 350 deg. C. For example, into a 4-5 liter vessel containing 700 gr. naphthalene and 40 gr. AlCl_3 , is introduced ethylene under a pressure of 80-85 atm. In the course of the reaction the pressure rises to about 120 atm. and finally falls to 10-15 atm. The yield in this procedure is about 1,300 gr. of dark brown, fluorescent oil with an Engler-viscosity of 4.8 at 50 deg. C., a flashpoint of 150 deg. C. and tar content of 0.1-0.2 per cent. Since this product is improved by distillation, high-grade transformer and lubricating oils, comparable with American oils, can

be obtained. Similar oils produced by the interaction of fluorides of boron and ethylene gas were already known last year. This process has seen remarkable development and it is claimed that boron fluoride yields oils with a higher hydrogen content than does AlCl_3 . The use of fluorine compounds is in great favor at present.

In a report on road tars, Dr. Mallison, Berlin, stated that only up to 10-15 per cent of bitumen may be dissolved in coal tar, higher additions resulting in heterogeneous mixtures.

High importance was attached to several reports on the carbonization and distillation of coal and lignite. Recognition is constantly growing that coal must no longer remain a mere fuel but become a raw material; this experience is reflected in such processes as that of Bergius and the water-gas synthesis of petroleum hydrocarbons, where the objective is not only motor fuel but also lubricants and other synthetic products.

THE semi-coke produced by distillation and low-temperature carbonization of lignites is still difficult to dispose of, as the market for household fuel is already satisfied and a feasible method of application in the iron industry has not yet been developed. The best application proposed thus far seems to be its use in a pulverized state in conjunction with carbonization power plants (Schwelkraftwerke), thus combining the production of energy and carbonization. On the other hand, the gasification of semi-coke may become important for the long-distance supply of gases.

The development of lignite carbonization plants has been promoted considerably by the use of the vertical rotary furnace of the Kohlenveredlungs A.G., Berlin (see *Chem. & Met.*, Vol. 34, p. 729, 1927). The coarse pieces of lignite enter this furnace through relatively small channels so that a large heat transfer is obtained, increased by the rotating and dispersing motion of the furnace. Five large carbonization plants using this system have been built in Hessen and Middle Germany. In one of these, 1,000 tons of crude lignite are produced daily in seven rotary units, and the combined yearly output of tar in the five plants will amount to 100,000 tons. The importance of this fact for Germany's oil supply is readily appreciated when it is considered that the old carbonization plants in Middle Germany produced only 65,000 tons a year in more than 1,000 ovens of the old type.

IN CONNECTION with the general present situation in Germany, it is known that the coal mining industry has during the past few years erected sev-

eral large plants for producing nitrogen fertilizers according to methods different from those employed by the I. G. Farben-industrie, and these have caused some patent litigation not yet decided. The principal reasons which induced the Montan Industrie to erect these plants lie in the fact that, in order to gain 1 kg. nitrogen (fertilizer), 5 kg. of coal are necessary, besides water and air. The nitrogen produced as ammonia in the distillation of coal amounts to only ten per cent of the annual German production of 700,000 tons. In the commercial exploitation of nitrogen the hydrogen is a decisive factor and when the hydrogen from water-gas is compared on an economical basis with that obtained up to 50 per cent from coal processing, the latter shows a considerable advantage. Hydrogen from water gas costs about 7 pfennig per cu.m., while that produced by the Rombach-Linde method (liquefaction at low temperature) comes to 4.5 pfennig per cu.m. And since 2.5 cu.m. of hydrogen is necessary for the fixation of 1 kg. of nitrogen it will be seen that 1 kg. of ammonia represents in the first case 17.5 pfennig and in the second only 11.25 pfennig for hydrogen. According to a report by Mr. Pott, presented at the Deutsche Bergmannstag at Berlin early in June, technical improvements will enable a further reduction in the price of hydrogen so that it will approach the limit of 6 and 2.25 pfennig, respectively.

Thus we may presently observe a violent competition between the large chemical and coal industries, revolving about the commercial exploitation of by-products, especially cheap fuels and fertilizer. This competition should certainly react to the profit of the German economic situation.

International approaches concerning the production of mixed fertilizer seem to have become closer. The Royal Agricultural Society, the Etablissements Kuhlmann, Paris, and the German Stickstoff-Syndikat have entered negotiations that are primarily directed toward questions of propaganda involving the tropical and subtropical countries.

New Test for Industrial Lead Poisoning

A NEW test for industrial lead poisoning, which uses the presence of basophilic red cells in the blood stream as an indicator is recommended in Bulletin No. 460 of the U. S. Bureau of Labor Statistics, by Carey P. McCord, of the Industrial Health Conservancy Laboratories, Cincinnati, Ohio. This document describes a method for early determination of cases in which lead poisoning of a serious nature threatens, and hence provides means for prompt removal of exposed workers from the hazard and immediate steps for lead elimination from their systems. It appears that the methods recommended will largely reduce the seriousness of lead poisoning in the case of workers inevitably suffering exposure in their regular work.

A.I.C.E. Meeting Attracts Many English Visitors

THE joint meeting of the American Institute of Chemical Engineers and the British Institution of Chemical Engineers, which will be held in August, will be featured the large attendance from England. The Society of Chemical Industry also has responded to the invitation to participate and will be well represented. The meeting will be held at Niagara Falls, Aug. 24-26, and in conjunction with it, there has been arranged an industrial tour of eastern Canada and the United States.

The visitors from England will include:

A. T. Abernethy, Stockton-on-Tees; W. Y. Agnew, Kilmarnock; G. H. Appleyard, Hull.

W. Bain, Cleckheaton; R. A. Banks, Northwich; Hugh Beaver; E. Beesley, Stockton-on-Tees; J. H. Birkinhshaw, Saltcoats; A. L. Booth, Burnley; Mrs. A. L. Booth; F. Bradley, Norton-on-Tees; C. W. Brisley, Saltcoats.

A. Callender, Northwich; F. H. Carr, London; Mrs. F. H. Carr, London; Miss M. Carr, London; Miss A. Carr, London; C. Carter, Liverpool; W. A. P. Challenor, Saltcoats; M. F. S. Choate, Manchester; P. Chorley, Manchester; J. G. Clark, London; R. T. Colgate, Reading; Mrs. R. T. Colgate, Reading; E. J. Conolly, Huddersfield; R. Cosway, Warrington; J. G. Cowan, Bradford; J. A. Cranston, Glasgow; Mrs. J. A. Cranston, Glasgow; Miss K. Culhane, London; Dr. W. Cullen, Surbiton; Mrs. W. Cullen, Surbiton; J. A. Currie, Norton-on-Tees.

W. E. Davies, London; W. G. Davis, Stockton-on-Tees; K. W. Dickins, Chalfont; W. D'Leny, Norton-on-Tees; L. H. Downs, Hull.

D. Eastwood, Hunslet; F. J. Eaton; A. Edwards, London; Mrs. A. Edwards, London.

R. C. Farmer, Sidecup; T. C. Finlayson; C. P. Finn, Rotherham; C. Hamilton Foott; Mrs. E. T. Foott; C. A. M. Foster, Northwich; G. H. Fulidge, London.

S. F. Gates, Runcorn; Sir Alexander Gibb; B. R. Goodfellow, Durham; F. A. Greene, London; Mrs. F. A. Greene, London; C. J. Goodwin, London; Mrs. C. J. Goodwin, London; F. C. Guthrie, Liverpool.

F. E. Hamer, London; G. J. Harris, Stockton; G. A. Hebdon, Rotherham; B. P. Hill, Blaydon; J. W. Hinckley, London; C. P. Holliday, London; W. Hoyland, Bersley; T. C. Humphreys, Birmingham.

W. Illingworth, Northwich; C. S. Imison, Dr. L. A. Jordan, Surbiton; Mrs. L. A. Jordan, Surbiton; J. W. Kerr, Stevenston; D. N. Laurie, London; J. M. Leonard, London; E. H. Lewis, Northwich; R. P. Littler, Bristol; I. P. Llewellyn, Widnes; Mrs. I. P. Llewellyn, Widnes; A. Lomax, Ainsworth; J. P. Longstaff, C. H. Lumsden, Manchester; F. S. Lundy, Billingham.

J. Manning, Norton-on-Tees; Dr. P. May, London; P. Mayne, Billingham; B. G. McLellan, York; J. W. McNyn, Manchester; T. H. Minton, Widnes; F. J. Moore, Saltcoats; T. O. Morgan, Manchester; Dr. R. S. Morrell, Wolverhampton; Mrs. R. S. Morrell, Wolverhampton; G. Morris, Saltcoats; D. G. Murphy, Stockton-on-Tees.

J. T. Nance, Bromborough; J. W. Napier, Alloa; P. B. Nicholson, Rotherham; G. Nonhebel, Norton-on-Tees.

R. B. Palmer, Norwich; W. H. Palmer, Warley; W. Pantin, Billingham; P. Parrish, Blackheath; T. R. Paterson, Ardeer; J. Payman, Huddersfield; W. Payman, Buxton; S. Pexton, London; Mrs. S. Pexton, London; W. G. Polack, Frodsham; Mrs. W. G. Polack, Frodsham; R. W. Pope, Huddersfield; F. M. Potter, London; C. A. Potter, Newcastle.

J. A. Reavell; Miss E. M. Reavell; A. Renfrew, Saltcoats; A. Riley, Huddersfield; C. Robinson, Northwich; W. D. Rogers, Manchester.

Miss J. Sawers; F. L. Sharp; D. H. Shiel, Saltcoats; J. Shufflebotham, Birmingham; T. A. Simmons, Huddersfield; C. C. Smith, Eaglescliffe; C. H. Smith, Brockley; R. C. Smith, Northwich; Dr. W. Smith, Chingford; C. E. Sosson, Saltcoats; W. C. Sprent, Liverpool; P. K. Standring, Whitby; Mrs. A. W. Stokes; G. A. Stokes.

H. Talbot, London; Mrs. H. Talbot, London; R. Thomas, Runcorn; W. Thomson, Saltcoats; J. F. Thorpe, London; Mrs. J. F. Thorpe, London; R. F. Twist, Blackheath.

W. Welch, Huddersfield; G. C. Whitham, London; E. Whitworth, Saltcoats; H. Witham, Manchester.
A. F. Young; H. M. V. Wright, Hull; M. Wyler, Crumpsall.

Large Soap Companies Will Consolidate

NEGOTIATIONS for a merger of Colgate & Co. and the Palmolive-Peet Company, makers of soaps and toilet goods, have been closed and the stockholders of the two companies will meet on July 20 to approve the merger. The new company will be known as the Colgate-Palmolive-Peet Company. Sidney M. Colgate will be Chairman of the Board of Directors.

While the terms of the merger have not been made public, Mr. Colgate said last week that no new financing will be involved, and that application for listing the securities of the Colgate-Palmolive-Peet Company on the New York Stock Exchange would be made as soon as the necessary transfer details can be completed. Large economies in manufacturing and distribution costs are expected to result from the consolidation, the combined sales of the companies totaling approximately \$100,000,000 annually.

The new company will have, as a result of the merger, large manufacturing units at Jersey City, Milwaukee, Chicago, Kansas City, Berkeley, Calif., Jeffersonville, Ind., and Portland, Ore. Manufacturing operations are also carried on in Canada, Australia, England, France, Germany, Italy, Denmark, Sweden, Cuba, Mexico, Argentina, and Brazil. Executive offices will be maintained at Chicago. At the present time there is in the course of construction a thirty-seven-story office building in Chicago which will house the offices as soon as completed.

News in Brief

BRITISH FINANCIAL interests, headed by Sir Alfred Mond, have taken an option on 12,000 acres between Fort McMurray and Fort McKay, northern Canada, in the name of the Imperial Chemicals, Ltd. It is thought experiments will be conducted by the Mond interests with a process by means of which oil is extracted from coal and from tar sands.

Announcement also has been made by Glen M. Ruby, vice-president and general manager of the Hudson Bay Maryland Oil Company, that plans have been prepared for a systematic investigation of the tar sands on which that company has obtained rights.

THE ITALIAN manufacturers of dyes and explosives, who control production in their own country, have concluded an agreement with the German, French, and Swiss producers, and are now included as the fourth member of the international dyestuffs cartel. While no public announcement has been made that the contract has been signed, it is stated to be in operation, and dyestuffs

imports into Italy, are to be on the basis of last year's figures. Germany has been allocated 70 per cent, followed by France with 20, and Switzerland with 10 per cent. It is believed that the same arrangement affects explosives.

DR. JOHN JOHNSTON, director of research and technology of the United States Steel Corporation; C. A. Reinhardt, chief metallurgist of the Youngstown Sheet and Tube Company; Dr. A. J. Unger, manager of the research bureau of the Carnegie Steel Company, and Homer D. Williams, president of the Pittsburgh Steel Company, have been invited by President Thomas S. Baker to become members of the advisory board of the Department of Metallurgical Engineering at Carnegie Institute of Technology.

THE PERFECTION OF a process of emulsifying asphalt has been announced by E. I. du Pont de Nemours & Company. The new product is intended for the protection of ferrous metal against rust and other corrosive influences, and for the preservation of wood. This new paint is described as asphalt chromate emulsion. The method of making differs from former processes, in that no solvents nor cut-back ingredients enter into the manufacture.

CONSTRUCTION OF A \$1,000,000 chemical plant in Tacoma, Wash., by the Hooker Electric-Chemical Co. has been announced. The Tacoma plant will be a Northwest branch of the Hooker Co. which operates its chief factory at Niagara Falls, N. Y. Original operations of the Tacoma plant will probably be limited to manufacture of caustic soda and liquid chlorine, but its construction is being planned along such lines that expansion into other fields will be possible.

ANNOUNCEMENT IS MADE that plans have been completed for a national celebration of American Ceramic Week, in connection with the 31st annual convention of the American Ceramic Society at the new Stevens Hotel, Chicago, Feb. 4-9, 1929. All trade associations in the ceramic field have been requested to plan their meetings to coincide with that of the American Ceramic Society and participate in the convention. A number have already agreed to do this.

UNFAIR TRADE PRACTICES in the paint, varnish, and lacquer industry will be considered at a trade practice conference to be held with the industry by the Federal Trade Commission, it was announced July 3. A date for holding the conference has not yet been set.

IN A PROTEST CASE of the Rhodia Chemical Company, the U. S. Customs Court held that aluminum sulphite containing less than 15 per cent alumina, with not more than an equivalent of one-tenth of one per cent of iron, is dutiable at three-eighths of one cent per pound, under the present tariff law, as claimed by the government, and not at 25 per cent, as all other aluminum salts, as claimed by the importer.

MEN in Chemical Engineering

PAUL D. V. MANNING, Pacific Coast editorial representative of *Chem. & Met.*, and recently appointed to serve in a similar capacity for the new *Food Industries*, has just been elected national president of Alpha Chi Sigma, professional chemical fraternity. He attended the annual conclave of the fraternity at Chapel Hill, N. C., and spent the week of June 25 in New York City.

GRANT B. SHIPLEY, chairman of the board and president of the American Mond Nickel Company, Limited, has recently been elected a director of the Mond Nickel Company, Limited, of England and Canada. Mr. Shipley is also president of the Century Wood Preserving Company, Pittsburgh.

ALDO LEOPOLD, associate director of the U. S. Forest Products Laboratory, left on July 1 to engage in private consulting work on forestry. Mr. Leopold was in his recent capacity since 1924, but had already spent nineteen years in various branches of the U. S. Forest Service.

DONALD M. LIDDELL, consulting chemical engineer, sailed on July 7 aboard the *France* for a trip to France, Italy and Spain. He expects to return on or about September 22.

CALENDAR

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, convention, New York City, Dec. 27, 1928-Jan. 2, 1929.

AMERICAN CHEMICAL SOCIETY, 76th meeting, Swampscott, Mass., Sept. 10-14.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Charleston-Huntington, W. Va., Sept. 20-22.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, tour, with British Institution of Chemical Engineers, Quebec, Shawinigan Falls, Montreal, Ottawa, Kirtland Lake, Port Colborne, Niagara Falls, Akron, Pittsburgh, Wilmington, Edgewood, Washington, and New York, August 18-Sept. 2.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, regional meetings, St. Paul-Minneapolis, Aug. 27-30, Boston, Oct. 1-3. Fuels Division, second national meeting, Cleveland, Sept. 17-20.

INSTITUTE OF CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY, second session, Evanston, Ill., July 23-August 18.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL, 2nd conference, Carnegie Institute of Technology, Pittsburgh, Nov. 19-24.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY, meeting, The Hague, July 18-24.

NATIONAL METAL WEEK, Philadelphia, Oct. 8-12.

GUSTAVE WHYTE THOMPSON was chosen president of the American Society for Testing Materials at its recent annual meeting in Atlantic City. His election to the leadership of the Society follows a period of active interest in its affairs, which he had already served as vice president in 1926.

Dr. Thompson's eminence lies chiefly in his pioneer chemical work in the field of pigments. Born in 1865, he joined



G. W. THOMPSON

the National Lead Company as chief chemist in 1892, a connection that he has maintained ever since. He became director of that firm in 1916 and during the subsequent years held executive posts in the Williams Harvey Corporation, Titanium Pigment Company, United Lead Company, and Metallurgical and Chemical Corporation.

Among Dr. Thompson's further activities for the technical societies was his presidency, in 1918, of the American Institute of Chemical Engineers.

C. HAROLD BERRY, who was for nearly three years an associate editor of *Power*, has been appointed professor of mechanical engineering at Harvard University, to succeed Dr. Harvey N. Davis, the recently elected president of Stevens Institute.

MICHAEL F. LAURO, flour chemist of the New York Produce Exchange and assistant chief of its bureau of chemistry, has received the degree of M.S. from the Brooklyn Polytechnic Institute.

S. H. CURRAN, production manager of the Royal Baking Powder Company, returned from Europe on the *Adriatic* on June 4 after spending several months visiting plants in Germany, Italy and France.

C. C. CONCANNON, chief of the chemical division of the Bureau of Foreign and Domestic Commerce, has returned from a two months' visit to Germany and France.

H. R. SMALLEY, of Washington, and JAMES C. PRIDMORE, of Atlanta, respectively Northern and Southern division soil improvement directors of the National Fertilizer Association, recently sailed for Europe. In behalf of the Association they will investigate economic and agronomic developments in Europe and visit many of the principal plants of interest to the fertilizer industry, gathering the latest information regarding world trends for the American fertilizer manufacturers and users.

ELIZABETH HUMES, assistant trade commissioner to Italy, is in this country for a short visit. She has prepared a special report on the development of the chemical industry in Italy.

CHARLES L. MANTELL, consulting chemical engineer and a member of the industrial chemical engineering department at Pratt Institute, Brooklyn, has joined the editorial staff of *Chem. & Met.* for special work during the summer months.

J. A. LECLERC, who has been serving as a grain specialist in the Department of Commerce, has transferred to the chemical and technologic research division of the Bureau of Chemistry and Soils, where he will be engaged in research on foodstuffs.

A. C. OLIPHANT has resigned as assistant secretary of the American Engineering Council to join the Washington office of the Joint Committee of National Utility Associations. He will be succeeded by Blake R. Vanleer.

HARRY NEWTON, who has been with the Dorr Company for eight years, is now leaving to become director of process research for the Portland Cement Association, with headquarters at Chicago.

JOSEPH H. SIMONS of the department of chemistry at Northwestern University will be on leave of absence during the coming year, in order to accept an International Education Board fellowship at Cambridge University, England.

C. W. STRATFORD, who has been connected successively with the Tidewater Oil Company, the U. S. Bureau of Standards, and the Associated Oil Company, San Francisco, has organized the Stratford Engineering Company for the supply of oil stills, distilling and treating equipment.

ERNEST BLAKER who was superintendent of the control division for the B. F. Goodrich Rubber Company, Akron, Ohio, is now with the Pacific Coast Goodrich Rubber Company as technical manager.

H. N. SPICER, on the New York staff of the Dorr Company, has returned from a seven months' tour of the Far East and of the Western States.

ROBERT GORDON GOULD, for many years associated with food processing both in its technical phases and as an editor, is now assistant editor of the new publication *Food Industries*. After attending the University of Chicago, Mr. Gould became acquainted with his field in several baking and corn products organizations, thereupon becoming owner and editor of *The American Food Journal*. In 1918 he came to New York to become vice-president and general manager of *The National Provisioner* and later secretary of the American Meat Packers Association, with which he moved to Chicago when it became the present Institute of American Meat Packers.

O. S. SLEEPER, formerly of the O. S. Sleeper Company and more recently connected with the Buffalo Foundry & Machine Company, has accepted the post of chief engineer for the H. G. Trout Company, Buffalo.

J. M. LOHR, formerly in charge of melting for the Haskins Manufacturing Company and later engaged by the Electrical Alloy Company for work on the treatment of nickel alloys, has now become plant metallurgist for the Driver-Harris Company, Harrison, N. J.

F. C. ALLEN, JR., founder and former president of Allen & Billmyre Company, has left that firm to become president of the Allen Air Appliances Company, New York.

FRANK C. WHITMORE, head of the department of chemistry at Northwestern University, has returned to Evanston following a year's leave of absence from university work. In addi-



FRANK C. WHITMORE

tion he will assume charge, in his capacity as director, of the Institute of Chemistry which meets in Evanston from July 23 to August 18. During the past year Dr. Whitmore performed his office as chairman of the division of chemistry and chemical technology of the National Research Council and served on the Central Petroleum Committee.

OBITUARY

EDWARD GRANVILLE NELLIS, president and co-organizer of the Chemical Catalog Company, died at his summer home in Quogue, Long Island, on June 27, a few days before completing his 49th year.

Mr. Nellis was a native of New York City and attended a preparatory school in Stamford, Conn. From there he went to Yale University and after his graduation began work in journalism and subsequently on several trade papers. It was in 1915, in conjunction with F. W. Robinson and Ralph Reinhold, that he organized the Chemical Catalog Company and became its vice-president. Following Mr. Robinson's retirement in 1926 he then became president, holding the same post for the Pencil Points Press, Inc., which publishes a magazine devoted to architecture.

CHARLES PLATT, author and chemist, at one time chief chemist for Thomas A. Edison at his private laboratories in Llewellyn Park, N. J., died on June 14 at his home in Ardmore after an illness of a year. He was in his sixtieth year. Dr. Platt was born in Montclair, N. J., and was graduated from Lehigh University in 1890.

MRS. JOHN V. N. DORR, wife of John V. N. Dorr, the president of the Dorr Company, died at her home in New York City on July 3rd.

H. WALKER WALLACE, vice-president of the Virginia-Carolina Chemical Corporation, died as a result of blood poisoning on June 22. He was a member of the soil improvement committee and a recently elected director of the National Fertilizer Association. During its meeting at Old Point Comfort, Mr. Walker had already contracted what proved to be his fatal illness.

H. W. CHAPPELL, retired manufacturing chemist, formerly head of the Chappell Chemical Company and for many years a director of the General Chemical Company, died on June 14 at the age of 71, after a brief illness from pneumonia. Mr. Chappell came of a family of chemists and entered the chemical manufacturing industry soon after his graduation from the Massachusetts Institute of Technology in 1878. He was first associated with the firm of Mahler & Chappell, later changed to the Chappell Chemical Company. This merged with several other concerns in the formation of the General Chemical Company.

WILLIAM ARBUCKLE JAMISON, one of the leading sugar refiners in the United States, died suddenly on June 28 at his home in New York at the age of 64, after an illness of eight months. He was one of the American representatives on the International Sugar Commission during the World War.

CHESTER E. ANDREWS, who for the past eleven years was chief chemist in charge of production for the Selden Company, Pittsburgh, has now resigned his position there.

FOSTER D. SNELL has given up his position as instructor in technical chemistry at Pratt Institute to enter a consulting chemical practice in Brooklyn.

WILLIAM H. FINKELEY was recently admitted to the firm of Singmaster & Breyer, chemical engineers and metallurgists, in New York.

INDUSTRIAL NOTES

THE ATLAS CONVEYOR COMPANY, Philadelphia, announces the appointment of A. J. Forschner, formerly of the R. H. Beaumont Company, as vice-president.

THE CHICAGO PNEUMATIC TOOL COMPANY has appointed G. J. Lynch district manager at 1931 Washington Ave., St. Louis.

OLIVER UNITED FILTERS, INC., is the name of the new consolidation formed by the Oliver Continuous Filter Company and United Filters Corporation. The main offices are at 503 Market St., San Francisco.

THE BROWN INSTRUMENT COMPANY, Philadelphia, announces the construction of another addition to its plant.

THE MERCO NORDSTROM VALVE COMPANY has appointed Roger Bowman manager of the Cleveland office. New offices are also being opened at 184 Boylston St., Boston, and Magnolia Building, Dallas, Texas.

THE ROLLER-SMITH COMPANY, New York, has assigned the Texas territory to J. A. Coleman, Houston, and the Southwest to H. T. Weeks, Denver, Col.

THE HEDGES-WALSH-WEIDNER COMPANY, at Chattanooga, Tenn., is the name of the firm formed by the merging of Casey-Hedges and Walsh & Weidner.

THE INDUSTRIAL CHEMICAL COMPANY, 200 Fifth Ave., New York, will henceforth be called the Industrial Chemical Sales Company, Inc., the organization remaining unchanged otherwise.

THE ALBERGER CHEMICAL MACHINERY COMPANY, 103 Park Ave., New York, has been appointed representative, with A. H. Alberger in charge, of the H. G. Trout Company, which recently extended its facilities for serving the chemical industries.

THE HANSON-VAN WINKLE-MANNING COMPANY, Matawan, N. J., has appointed George Smith vice-president in charge of the Central and Western states.

THE COMBUSTION ENGINEERING CORPORATION has appointed James Cleary general sales manager.

THE LITTLE RIVER REDWOOD COMPANY has placed T. F. Egan in charge of sales in the East for the technical division, his headquarters being at 103 Park Ave., New York.

THE C. O. BARTLETT & SNOW COMPANY, Cleveland, has opened a new Chicago office at 505 First National Bank Building, in charge of S. G. Artingstall.

MANNING, MAXWELL & MOORE, INC., New York, announce the purchase of the American Schaeffer and Budenberg Corporation, which will now carry on business in conjunction with the Consolidated Ashcroft, Hancock Company, another subsidiary firm.

THE COLUMBUS MCKINNON CHAIN COMPANY, Tonawanda, N. Y., has purchased the Chisholm-Moore Manufacturing Company, Cleveland, and will operate it under the new name Chisholm-Moore Hoist Corporation.

THE PUBLICKER COMMERCIAL ALCOHOL COMPANY has removed its offices to Atlantic Building, 260 South Broad St., Philadelphia.

THE STANDARD ALLOY COMPANY has been formed at Cleveland, Ohio, for the purpose of manufacturing alloys for heat and corrosion resistance.

THE ROESSLER & HASSLACHER CHEMICAL COMPANY has appointed Philipp Moll, formerly a vice-president of the Dissoway Chemical Company, as assistant manager of sales.

THE FERRO ENAMEL SUPPLY COMPANY has added D. L. Cable to its staff as representative on coloring or porcelain ware.

THE JOSEPH DIXON CRUCIBLE COMPANY has moved its Chicago office to 2003 Builders Building, Wacker Drive.

THE BOSTON WOVEN HOSE & RUBBER COMPANY has appointed A. C. Kingston assistant general manager in charge of sales.

MARKET CONDITIONS and PRICE TRENDS

Synthetic Camphor Competes with the Natural Product

Domestic Production and Increased Imports Attest Growth of Synthetic Industry

WHEN THE celluloid industry to assume large proportions, it had the effect of creating a wider consuming outlet for camphor. This, in turn, directed research work toward the development of a synthetic product with a varying degree of success. In recent years, France attempted to establish synthetic production of camphor but results were not satisfactory. Germany has made considerable progress in that direction and, in addition to taking care of the home trade, exports considerable quantities of synthetic camphor every year. Earlier production of the synthetic material in the United States was curtailed when the price for turpentine was advanced to unusually high levels and quotations for natural camphor were lowered. Later domestic production was again taken up and has made satisfactory progress. A review of the situation reveals that synthetic production in this country and in Germany has had a material bearing on the natural camphor industry.

In a recent report from the United States consul at Taihoku, Japan, it was stated that approximately 77 per cent of the world's camphor trees existing at the present time are found in Taiwan, about 15 per cent in Japan proper, and 8 per cent in southern China. The natural camphor industry in Taiwan has been a government monopoly since 1899, four years after the cession of Taiwan to Japan by China in May, 1895. In 1903, by enactment of the Imperial Diet, crude camphor, with camphor oil, in Japan proper as well as in Taiwan, was made a government monopoly. This Japanese-Taiwan monopoly has since controlled output and prices of the world's natural camphor, a large proportion of China's camphor trees having been gradually acquired by the monopoly by arrangement or purchase during the intervening 23 years.

Camphor is indispensable in the manufacture of pyroxylin plastics such as celluloid, pyralin, fiberoid, viscoloid, zylonite, and similar products.

SYNTHETIC camphor is the monopoly's only rival. Attempts to grow camphor trees, for commercial purposes, in Java, Ceylon, Madagascar, Egypt, Italy, France, Brazil and in parts of the United States, have ended in discouragement, due chiefly to the

fact that half a century is required to produce a tree of profitable yield and that the tree is necessarily destroyed in the process of obtaining the camphor content.

The rivalry between the monopoly's natural camphor and synthetic camphor has developed into a very acute stage within the last two years. In Taiwan, the revenues realized by the government from the camphor industry have been substantial, averaging annually more than \$800,000 gold, in the 25 years from the inception of the monopoly in 1899 to 1923: A traditional and profitable industry, giving employment all the year round to about 15,000 persons, has been maintained; dividends in excess of 8 per cent have uniformly accrued to the stockholders of the Taiwan Camphor Producing Company, Limited, which has, since April, 1919, been vested with all crude camphor and camphor oil producing rights in Taiwan. The Japan Camphor Company, Ltd., of Kobe, since 1918 the sole authorized wholesale marketing medium for Japanese and Formosan camphor whether in the form of camphor oil, crude camphor in its several grades, or refined camphor, has been enabled to make satisfactory earnings on its 6,750,000 yen paid-up of 9,000,000 yen authorized capital stock.

THE strength of the synthetic product's competition, especially in the crude camphor market in the United States, induced the Government General of Taiwan to issue an order, effective May 1, 1926, reducing the price to be paid to the Taiwan Camphor Producing Company, Limited, by the Bureau of Monopolies about 25 per cent on all grades. The order stipulated that the wages of camphor workers should not be reduced on account of such reduction in prices. This reduction in the cost of camphor to the Bureau resulted in reduced export prices from July, 1926. German synthetic prices were at once lowered, and on January 1, 1927, and again in August, 1927, further export price reductions were made by the Japanese-Taiwan monopoly. In effecting these latter reduction in export prices corresponding reductions were made in the prices paid by the Bureau to the producing company, resulting in various economies and the discharge of a number of camphor workers in the

mountain areas and of employees at the collecting agencies and at the Bureau's Taihoku camphor factory, in a decision by the Government General of Taiwan to restrict production, to intensify efforts to enlarge the sales of refined camphor, to produce and market profitable by-products, to eliminate from the budget for the fiscal year beginning April 1, 1928, any item of revenues to accrue from the monopoly on camphor, and to refrain in the future from publishing statistics of camphor production, production costs, or other information likely to be helpful to synthetic producers in the marketing of their product.

Developments, dependent in the main on the ability of synthetic producers to make lower prices than those that now prevail, may be watched with interest. If the Taiwan government shall be content to forego all or a large part of its revenues from the monopoly on camphor, and talked of economics are practised by the producing company, natural camphor can offer prices lower than any yet quoted for either the natural or the synthetic product.

TAIWAN'S production, at the mountain stills, of camphor and camphor oil, respectively, have averaged annually throughout the 26 years from the establishment of the government's monopoly of camphor to March 31, 1925, some 4,379,541 lb. of crude camphor and 6,014,661 lb. of camphor oil.

According to these official statistics, the production in the year 1913 amounted to 6,327,188 lb. of crude camphor and 6,428,933 lb. of camphor oil; in 1924, to 2,621,584 lb. of crude camphor and 5,322,577 lb. of camphor oil; in 1925, to 2,447,043 lb. of crude camphor and 5,019,131 lb. of camphor oil. Semi-official figures, believed to be fairly accurate, give the production for 1926 as 1,665,317 lb. of crude camphor and 4,633,284 lb. of camphor oil, and for 1927 substantially the same as for 1926. The restriction of output in 1926 and 1927 is attributed to decrease in the natural camphor demand in the United States due to increased consumption of the synthetic product.

Imports of camphor into the United States show as follows:

Imports of Camphor Into United States

| | Camphor Natural Crude, Lb. | Camphor Refined, Lb. | Camphor Synthetic, Lb. |
|-----------|-------------------------------------|----------------------------|------------------------------|
| 1918..... | 3,638,384 | 1,145,244 | ..... |
| 1919..... | 2,622,792 | 1,497,159 | ..... |
| 1920..... | 3,961,252 | 1,367,263 | 116,100 |
| 1921..... | 2,045,273 | 801,529 | 123,686 |
| 1922..... | 1,667,278 | 1,596,757 | ..... |
| 1923..... | 3,477,034 | 2,176,687 | 293,933 |
| 1924..... | 2,137,560 | 2,659,071 | 460,734 |
| 1925..... | 2,369,413 | 1,583,902 | 1,834,988 |
| 1926..... | 2,018,971 | 1,169,779 | 2,944,478 |
| 1927..... | 1,689,714 | 1,480,851 | 2,935,784 |

MARKET APPRAISAL OF CHEMICAL INDUSTRY

American Cyanamid To Offer New Stock

AMERICAN CYANAMID CO. will offer stockholders the right to subscribe to one new share of Class B common at \$20 for every two shares of Class A and/or Class B common held. Present dividend rate of \$1.60 a share will be continued on the new stock. Rights will accrue to stockholders of record July 16 and will expire Aug. 6. Additional cash amounting to \$3,297,000 to be obtained by the sale of this stock will be used for additions to the company's plants at Niagara Falls, Canada, and Warners, N. J., for new plants on property recently acquired at Linden, N. J., and for working capital required in the expanded business.

Spencer Kellogg & Sons To Increase Capital

DIRECTORS of Spencer Kellogg & Sons, Inc., passed a resolution to increase the capital stock to 600,000 shares of no-par value from 250,000 shares of \$100 par. Directors also passed resolution to issue to stockholders of record July 9 five shares of new no-par value stock in exchange for each share of \$100 par stock held. Stockholders' meeting to vote on these resolutions will be held July 24.

Devoe & Raynolds Show Gain

Devoe & Raynolds Co., Inc., and subsidiaries, report for six months ended May 31, 1928, profit of \$606,557, after expenses and charges but before federal taxes, comparing with \$541,805 in first half of previous fiscal year. Outstanding stock consists of \$1,716,100 first preferred, \$935,500 second preferred, 95,000 shares of no-par Class A common, and 40,000 no-par of Class B common stock.

Lehn & Fink Profits Larger

The Lehn & Fink Products Company reports preliminary consolidated net profits of \$1,051,000 after tax reserve for the half year ended on June 30, equal, after dividends on management stock at the annual rate of 30 cents a share, to \$3.48 a share on 295,000 common shares. This compares with net profits of \$650,564 or \$2.28 a share on 275,000 common shares outstanding in the corresponding period of 1927.

Chickasha Cotton Oil Expands

Stockholders of Chickasha Cotton Oil Co. will meet on July 18 to ratify the acquisition of Anadarke Cotton Oil Co., Mangum Cotton Oil Mills Co., and Hollis Cotton Oil Co.

| Price Range Since Jan. 1 | | Stock | Price Range for Month | | |
|--------------------------|-----|-------------------------|-----------------------|------|-----|
| High | Low | | June 9 | High | Low |
| 31 | 22 | Aetol Products | 23 | 23 | 22 |
| 197 | 120 | Aluminum Co. | 165 | 165 | 134 |
| 74 | 59 | Air Reduction | 66 | 68 | 59 |
| 14 | 7 | Ajax Rubber Co. | 8 | 8 | 7 |
| 182 | 146 | Allied Chemical | 169 | 174 | 162 |
| 125 | 120 | Allied Chemical, pf | 122 | 122 | 120 |
| 163 | 101 | Amalgamated Leather | 11 | 11 | 10 |
| 232 | 151 | Am. Ag. Chemical | 19 | 20 | 18 |
| 75 | 55 | Am. Ag. Chemical, pf | 67 | 71 | 62 |
| 53 | 38 | American Cyanamid, B | 44 | 45 | 41 |
| 151 | 101 | Am. Hide & Leather | 10 | 11 | 10 |
| 118 | 56 | American Linseed | 115 | 118 | 105 |
| 130 | 86 | American Linseed, pf | 115 | 130 | 111 |
| 51 | 39 | American Metals | 47 | 49 | 45 |
| 24 | 13 | Am. Rayon Products | 22 | 22 | 17 |
| 28 | 11 | Am. Solvents & Chemical | 20 | 22 | 19 |
| 54 | 26 | Anglo. Chile Nitrate | 43 | 47 | 39 |
| 97 | 55 | Archer-Daniels-Midland | 83 | 86 | 77 |
| 32 | 28 | Ass. Dyeing & Printing | 31 | 31 | 28 |
| 101 | 63 | Atlas Powder | 79 | 79 | 73 |
| 20 | 12 | Beecon Oil | 14 | 17 | 14 |
| 83 | 70 | Beech-Nut Packing | 76 | 76 | 70 |
| 78 | 65 | Bon Ami, A. | 71 | 72 | 68 |
| 74 | 65 | Bristol-Myers | 69 | 69 | 65 |
| 31 | 24 | Calif. Petroleum | 29 | 31 | 28 |
| 103 | 70 | Celanese Corp. | 75 | 80 | 76 |
| 185 | 138 | Celanese Corp., 1 pf | 150 | 150 | 138 |
| 63 | 40 | Certaintead Products | 47 | 47 | 41 |
| 52 | 45 | Chickasha Cot. Oil | 47 | 50 | 45 |
| 189 | 137 | Commercial Solvents, B | 163 | 163 | 137 |
| 82 | 64 | Corn Products | 71 | 73 | 67 |
| 146 | 138 | Corn Products, pf | 144 | 144 | 144 |
| 57 | 34 | Davison Chemical | 45 | 52 | 42 |
| 61 | 40 | Devoe & Reynolds | 51 | 51 | 49 |
| 120 | 108 | Devoe & Reynolds, pf | 117 | 117 | 114 |
| 91 | 43 | Duz Corporation | 8 | 9 | 7 |
| 405 | 310 | Du Pont | 382 | 385 | 341 |
| 121 | 115 | Du Pont, 6 pc. db | 118 | 118 | 116 |
| 186 | 163 | Eastman Kodak | 177 | 178 | 170 |
| 238 | 166 | Firestone Tire | 170 | 170 | 170 |
| 171 | 111 | Fish Rubber | 14 | 14 | 11 |
| 76 | 65 | Fleischmann | 68 | 71 | 65 |
| 109 | 63 | Freeport Texas | 70 | 72 | 63 |
| 26 | 20 | Glidden | 24 | 24 | 21 |
| 104 | 95 | Glidden, pf | 100 | 101 | 100 |
| 105 | 71 | Gold Dust | 90 | 92 | 85 |
| 99 | 68 | Goodrich Tire | 76 | 76 | 76 |
| 167 | 119 | Houston Oil | 137 | 137 | 137 |
| 84 | 59 | Humble Oil | 76 | 80 | 75 |
| 26 | 15 | Industrial Rayon, A | 20 | 20 | 16 |
| 20 | 13 | Int. Ag. Chemical | 18 | 18 | 16 |
| 80 | 48 | Int. Ag. Chemical, pf | 76 | 80 | 75 |
| 86 | 66 | International Paper | 73 | 75 | 66 |
| 69 | 49 | International Salt | 59 | 61 | 59 |
| 27 | 15 | Kelly-Springfield | 19 | 21 | 17 |
| 24 | 17 | Lee Rubber & Tire | 19 | 21 | 17 |
| 53 | 38 | Lehn & Fink | 46 | 52 | 40 |
| 139 | 109 | Libby-Owens | 130 | 130 | 118 |
| 77 | 63 | Liquid Carbonic | 69 | 69 | 65 |
| 137 | 117 | Mathieson Alkali | 127 | 127 | 119 |
| 130 | 115 | Mathieson Alkali, pf | 120 | 125 | 120 |
| 58 | 29 | Natl. Dist. Products | 36 | 38 | 30 |
| 147 | 139 | National Lead | 124 | 124 | 116 |
| 275 | 180 | New Jersey Zinc | 217 | 218 | 210 |
| 68 | 58 | Ohio Oil | 62 | 63 | 62 |
| 95 | 74 | Owens Bottle | 83 | 83 | 78 |
| 123 | 85 | Palmolive-Pet | 100 | 123 | 100 |
| 245 | 210 | Pittsburgh Pl. Glass | 223 | 245 | 223 |
| 61 | 51 | Pratt & Lambert | 55 | 55 | 53 |
| 300 | 247 | Procter & Gamble | 283 | 284 | 280 |
| 27 | 19 | Pure Oil | 22 | 23 | 20 |
| 79 | 65 | Sherwin-Williams | 79 | 73 | 79 |
| 29 | 17 | Silica Gel | 24 | 24 | 22 |
| 30 | 17 | Sinclair Oil | 22 | 24 | 21 |
| 34 | 25 | Skelly Oil | 28 | 30 | 28 |
| 63 | 53 | Standard Oil, Calif. | 56 | 59 | 54 |
| 49 | 37 | Standard Oil, N. J. | 42 | 44 | 42 |
| 41 | 28 | Standard Oil, N. Y. | 33 | 36 | 31 |
| 7 | 24 | Standard Pl. Glass | 41 | 41 | 4 |
| 49 | 31 | Sun Oil | 43 | 44 | 40 |
| 23 | 16 | Swan & Finch | 22 | 22 | 20 |
| 16 | 10 | Tenn. Copper & Chemical | 14 | 14 | 14 |
| 66 | 50 | Texas Company | 58 | 62 | 55 |
| 80 | 62 | Texas Gulf Sulphur | 67 | 71 | 62 |
| 630 | 450 | Tidewater Oil | 24 | 24 | 16 |
| 162 | 136 | Tubize Silk | 554 | 574 | 460 |
| 57 | 42 | Union Carbide | 147 | 153 | 137 |
| 122 | 102 | Union Oil, Calif. | 50 | 53 | 45 |
| 51 | 22 | United Piece Dye Works | 81 | 81 | 72 |
| 63 | 27 | U. S. Ind. Alcohol | 105 | 113 | 102 |
| 87 | 72 | U. S. Leather | 41 | 44 | 35 |
| 96 | 60 | U. S. Rubber | 38 | 40 | 27 |
| 74 | 58 | Vacuum Oil | 77 | 77 | 72 |
| 164 | 12 | Vanadium Corp. | 80 | 80 | 65 |
| 53 | 44 | Vick Chemical | 69 | 71 | 65 |
| 16 | 67 | Va. Ca. Chemical | 14 | 14 | 12 |
| 16 | 111 | Va. Ca. Chemical, pf | 50 | 50 | 45 |
| 85 | 67 | Wesson Oil | 78 | 83 | 75 |
| 16 | 111 | Wilson & Co. | 141 | 141 | 121 |

ECONOMIC INFLUENCES on production and consumption of CHEMICALS

Prospects Favor Large Production of Chemicals in Third Quarter

Seasonal Influences Cause Slowing Up in Current Manufacturing Operations

UNDERLYING conditions in the industries which offer large outlets for chemicals, are regarded as pointing toward active operations for the third quarter of the year. This, in turn, presages large consumption of chemicals and other raw materials. Building projects are holding up well and give confidence in a continued large demand for paints, pigments, colors, etc. These materials also face favorable prospects as a result of predictions that automobile production will remain on a high scale. The outlook for tire production, likewise, is promising and reports from plate glass manufacturers agree that buying for automobile account has been more active than had been anticipated. The rayon industry has called heavily upon chemical producers so far this year and production programs encourage the belief that this condition will hold good over the remainder of the year.

The tanning industry has shown improvement recently but cotton textiles still suffer from overproduction and future activities are regarded as somewhat doubtful. Soap makers report satisfactory conditions with a slight increment in production for the year to date as compared with the corresponding period of 1927.

MORE or less definite views on the probable movement of commodities during the present quarter of the year may be gained by reference to the report on transportation requirements, as issued early this month by the Car

reported for all sections of the country with the exception of the Ohio Valley, and Central Western divisions where declines of 5 per cent and 3.2 per cent, respectively are indicated. The largest gains are reported for the Middle West and Allegheny divisions, which are largely explained by expected increases in shipments of coal which were cut down last year by labor troubles.

Referring to some of the chemical and allied groups, the report places the movement, for the quarter, of chemicals and explosives at an advance of 4.7 per cent, petroleum and petroleum products at an advance of 10 per cent, salt at a decline of 5.3 per cent, and fertilizer at a loss of 2.7 per cent, the comparison in each case being with the third quarter of last year.

DEMAND for chemicals throughout the last month has been of a declining tendency, both as far as contract withdrawals were concerned and in the volume of new business. The slower position of the market is described as due to seasonal influences and both production and distribution of chemicals compare favorably with the corresponding period of 1927. Some accumulations are reported for raw materials and for finished products but they have had no market effect with the exception of creating a slightly easier price tone. The monthly index for commodity stocks at the end of May was placed at 139 as compared with 133 for the preceding month, and 135 for May,

Operations in Specified Chemical and Chemical-Consuming Industries, April-May, 1927-1928

| | 1928 | | 1927 | |
|---|---------|---------|---------|---------|
| | April | May | April | May |
| Production: | | | | |
| Acetate of lime, 1,000 lb. | 11,693 | 10,986 | 13,130 | 12,552 |
| Methanol, crude, gal. | 607,253 | 559,604 | 666,638 | 638,376 |
| Methanol, ref., gal. | 468,448 | 557,780 | 420,741 | 426,304 |
| Chemical wood pulp, ton. | 210,780 | 229,924 | 218,996 | 214,848 |
| Automobiles—Cars, number: | 364,877 | 375,798 | 357,009 | 357,150 |
| Trucks, number: | 45,312 | 50,192 | 47,750 | 46,965 |
| Byproduct coke, 1,000 tons. | 3,925 | 4,084 | 3,880 | 3,788 |
| Plate glass, 1,000 sq.ft. | 9,953 | 10,224 | 11,641 | 9,618 |
| Glass containers, 1,000 gross. | 2,421 | 2,688 | 2,205 | 2,197 |
| Oleomargarine, 1,000 lb. | 24,291 | 23,744 | 23,569 | 20,917 |
| Cottonseed oil, crude, 1,000 lb. | 56,945 | 24,437 | 108,387 | 62,182 |
| Petroleum refining (run to stills) 1,000 bbl. | 72,979 | 77,311 | 66,624 | 69,759 |
| Consumption: | | | | |
| Wool in textile mills, grease equivalent, 1,000 lb. | 38,855 | 43,911 | 43,971 | 44,338 |
| Cotton in textile mills, bales. | 525,158 | 577,710 | 618,279 | 629,948 |
| In oleomargarine: | | | | |
| Cottonseed oil, 1,000 lb. | 2,013 | 2,135 | ..... | 1,974 |
| Coconut oil, 1,000 lb. | 12,284 | 11,613 | ..... | 8,734 |

Service Division of the American Railway Association. This report is based on twenty-nine groups of commodities and states that car requirements for their movement will exceed those for the corresponding quarter of 1927 by 6.4 per cent. Increased movements are

1927. The index for unfilled orders at the end of the month, according to the Department of Commerce, was 73 for May, 77 for April, and 74 for May, 1927. These indexes would indicate that unsold stocks were higher than was the case a year ago.

LATEST available figures, those for May, reveal a healthy condition in export trade for chemicals. Outward shipments in that month were valued at \$12,816,063 which compares with a valuation of \$11,795,876 for May, 1927. A large part of the increase in export trade was reported for the industrial chemical group with a noteworthy gain in shipments of bleaching powder. Sodium compounds also were shipped abroad in larger volume than a year ago with borax accounting for the major part of the increase. Shipments of caustic soda to foreign countries were unusually low in May and for the five months ended are more than 25 per cent below the total for the corresponding period of 1927.

Increases also are noted in importations of chemicals in May, total values being \$11,932,419 and \$9,877,583 for May, 1928 and May, 1927, respectively. Increases in imports, however, were largely due to heavier arrivals of fertilizer materials, especially of nitrate of soda and potash salts.

Tartaric Acid Production Gained in 1927

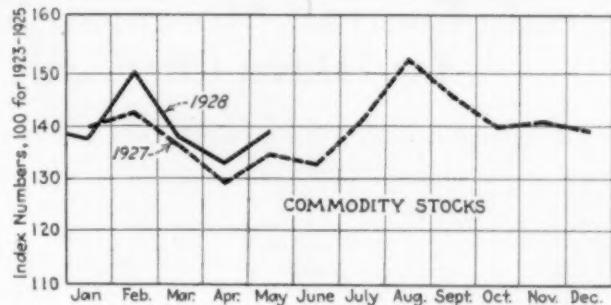
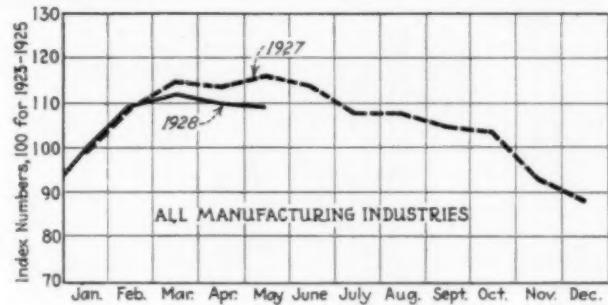
THE Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1928, 5,781,166 lb. of tartaric acid, valued at \$1,810,898, and 7,222,217 lb. of potassium bitartrate (cream of tartar), valued at \$1,653,653, were produced in 1927. As compared with 5,498,920 lb. of tartaric acid, valued at \$1,541,955, and 7,072,651 lb. of potassium bitartrate, valued at \$1,472,082, produced in 1925, the last preceding census year, these figures show increases of 5.1 per cent in quantity and 17.4 per cent in value for tartaric acid and 2.1 per cent in quantity and 12.3 per cent in value for potassium bitartrate.

The production of tartaric acid and of potassium bitartrate in 1927 was reported by 4 establishments, located as follows: 2 in New York, 1 in California, and 1 in Ohio.

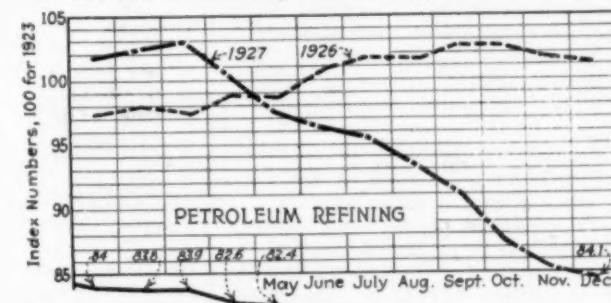
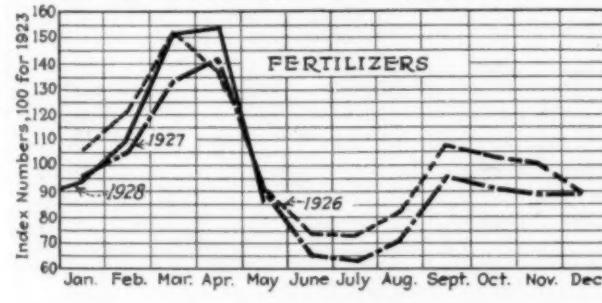
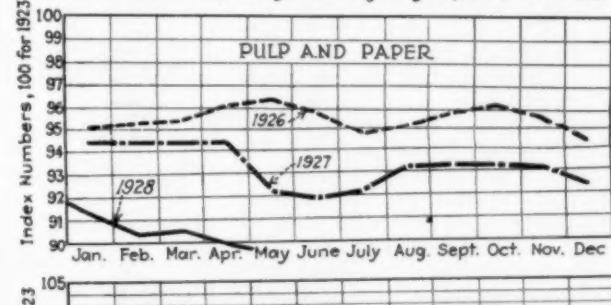
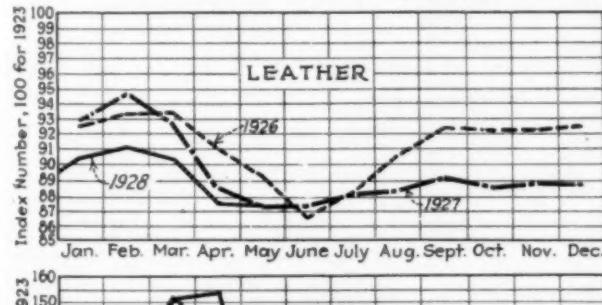
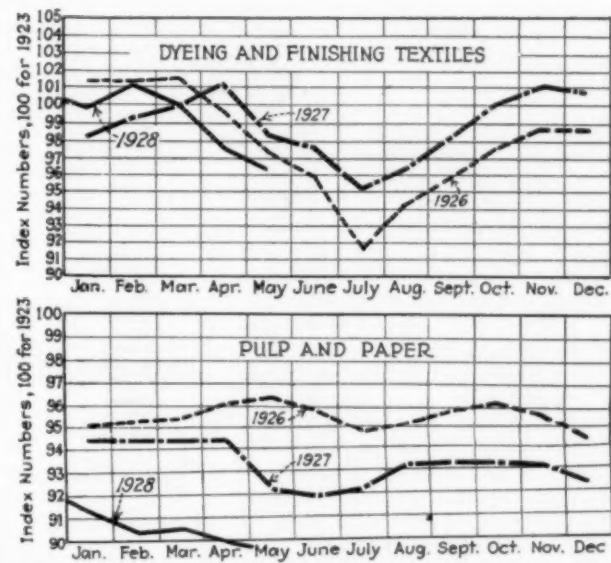
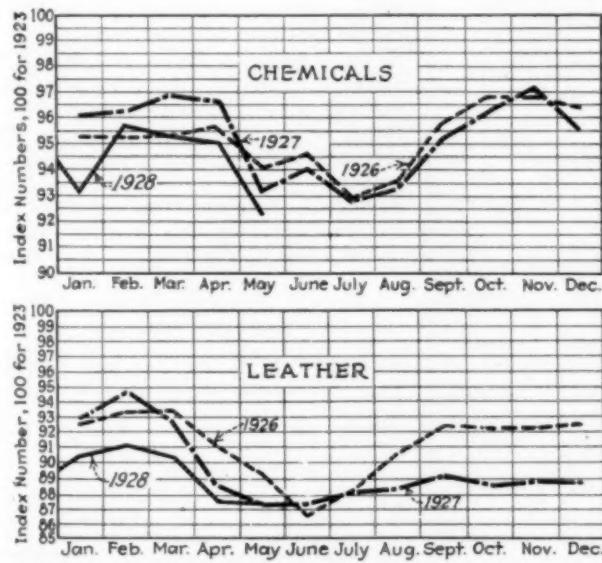
The following statement shows the production of tartaric acid and potassium bitartrate, as reported for each of the last three census years:

| | Production of Tartaric Acid and Potassium Bitartrate: 1927, 1925, and 1923 | | |
|--|--|-------------|-------------|
| | 1927 | 1925 | 1923 |
| Tartaric acid: | | | |
| Number of establishments..... | 4 | 4 | 4 |
| Pounds..... | 5,781,166 | 5,498,920 | 5,868,000 |
| Value..... | \$1,810,898 | \$1,541,955 | \$1,544,431 |
| Potassium bitartrate (cream of tartar): | | | |
| Number of establishments..... | 4 | 5 | 4 |
| Pounds..... | 7,222,217 | 7,072,651 | 5,971,186 |
| Value..... | \$1,653,653 | \$1,472,082 | \$1,746,363 |

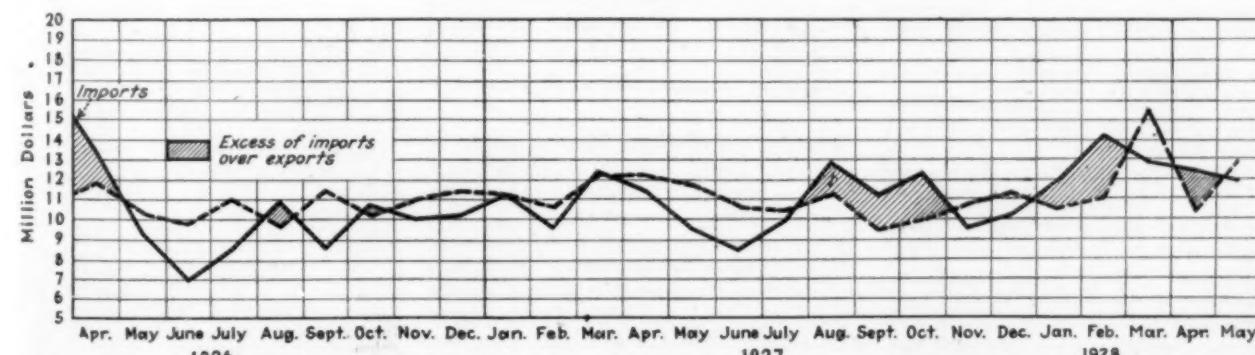
INDEXES OF ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



VOLUME OF PRODUCTION (U. S. Dept. of Commerce)



FACTORY EMPLOYMENT (U. S. Dept. of Labor)



FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS

MARKET CONDITIONS and PRICE TRENDS

Steady Contract Movement Reported for Heavy Chemicals

Trading in Spot Market Restricted in Volume With Competitive Conditions Prevailing

ALTHOUGH some of the large consuming trades have cut down their requirements, a steady movement of heavy chemicals against existing contracts is absorbing the greater part of production. New business is not coming to hand in large volume and spot transactions are restricted to actual wants. Evidences of stock accumulations are found in the fact that some chemicals have sold for export at prices below those quoted for domestic delivery. Price shading also has been noted in sales for domestic account but in the main, competitive conditions have been held within bounds and optimism is voiced regarding the future status of the market.

Coal-tar chemicals, generally, are maintaining a steady course. Toluol is well sold ahead and offerings of naphthalene are limited. Benzol is moving freely at unchanged prices and there has been no let-down in the firm position of cresylic acid.

Reports that new production of sulphur will start in Texas in September has been without market significance and the firm position of this chemical as well as of sulphuric acid may be explained by the report that acid phosphate production for the six-month period, December-May, was 2,052,610 tons as against 1,528,747 tons for the corresponding period of the preceding year. This represents an increase of 34.3 per cent which may be taken as approximately representing the gain in sulphuric acid consumption in the fertilizer trade during that period.

SOAP makers have been interested in a report from our trade commissioner at Oslo, Norway, which states that an international whale oil pool reported formed recently in Norway is said to have purchased three-quarters of the world's output for next year. The pool is said to consist of the Norwegian Company De-No-Fa at Oslo, Lever Brothers at London, the International Margarine Union at Rotterdam and Oslo and the Calve company at Delft, Netherlands. The amount of whale oil of the 1928-29 yield reported contracted by the pool is placed at 80,000 to 100,000 tons or 400,000 to 600,000 bbl. The oil is for delivery April to August of next year. The contract for all purchases is said to have reached between two and three million pounds sterling. Imports of whale oil into this country for the five months ended May were 8,785,634 gal.

Industrial Building Gains Over 1927

Contracts for industrial building construction in the first five months of this year total \$124,693,000, compared with \$97,947,000 in the same period of 1927. These figures were compiled by the Business News Department of the McGraw-Hill Publishing Company. New contracts, as referred to the process industries, compare as follows:

| | Total Jan. 1 to June 1 1928 | 1927 |
|---------------------|--------------------------------|--------------|
| Food Products: | | |
| Value..... | \$13,445,000 | \$11,995,000 |
| Number..... | 74 | 84 |
| Textiles: | | |
| Value..... | 3,213,000 | 2,183,000 |
| Number..... | 24 | 22 |
| Leather: | | |
| Value..... | 336,000 | 199,000 |
| Number..... | 6 | 3 |
| Rubber Products: | | |
| Value..... | 965,000 | 943,000 |
| Number..... | 4 | 7 |
| Paper and Pulp: | | |
| Value..... | 5,880,000 | 808,000 |
| Number..... | 10 | 5 |
| Heavy Chemicals: | | |
| Value..... | 3,120,000 | 945,000 |
| Number..... | 14 | 6 |
| Fine Chemicals: | | |
| Value..... | 625,000 | 479,000 |
| Number..... | 4 | 3 |
| Coke: | | |
| Value..... | 100,000 | ..... |
| Number..... | 1 | ..... |
| Manufactured Gas: | | |
| Value..... | 8,100,000 | 985,000 |
| Number..... | 2 | 7 |
| Oils, Veg., Animal | | |
| Value..... | 56,000 | 350,000 |
| Number..... | 1 | 2 |
| Paints, Varnishes: | | |
| Value..... | 650,000 | 435,000 |
| Number..... | 8 | 4 |
| Petroleum Refining: | | |
| Value..... | 1,462,000 | 3,859,000 |
| Number..... | 8 | 18 |
| Rayon: | | |
| Value..... | 10,040,000 | ..... |
| Number..... | 2 | ..... |
| Soap: | | |
| Value..... | 140,000 | 410,000 |
| Number..... | 1 | 3 |
| Other Process Ind.: | | |
| Value..... | 2,853,000 | 2,094,000 |
| Number..... | 11 | 11 |
| Glass: | | |
| Value..... | 2,140,000 | 425,000 |
| Number..... | 3 | 4 |

Explanation of this change in market position, it is stated that production of wood distillation chemicals has been curtailed recently and demand has been active enough to draw heavily upon reserve stocks. The strength in methanol comes at a time when rumors have been predicting an increase in production of the synthetic product.

Another development of the month which has aroused interest in trade circles was the information afforded in official preliminary reports on cotton and flaxseed acreages in this country. The figures on cotton acreage indicated a gain of 11.4 per cent over the acreage sown last year. Cottonseed production has a direct bearing on probable output of cottonseed oil and cottonseed oil is an important factor in influencing price levels for fats, edible and soap-making oils. If conditions throughout the growing period are favorable—and this takes into consideration, possible ravages of the boll weevil—a large supply of cottonseed would be available for the coming fiscal year with a corresponding effect on market values.

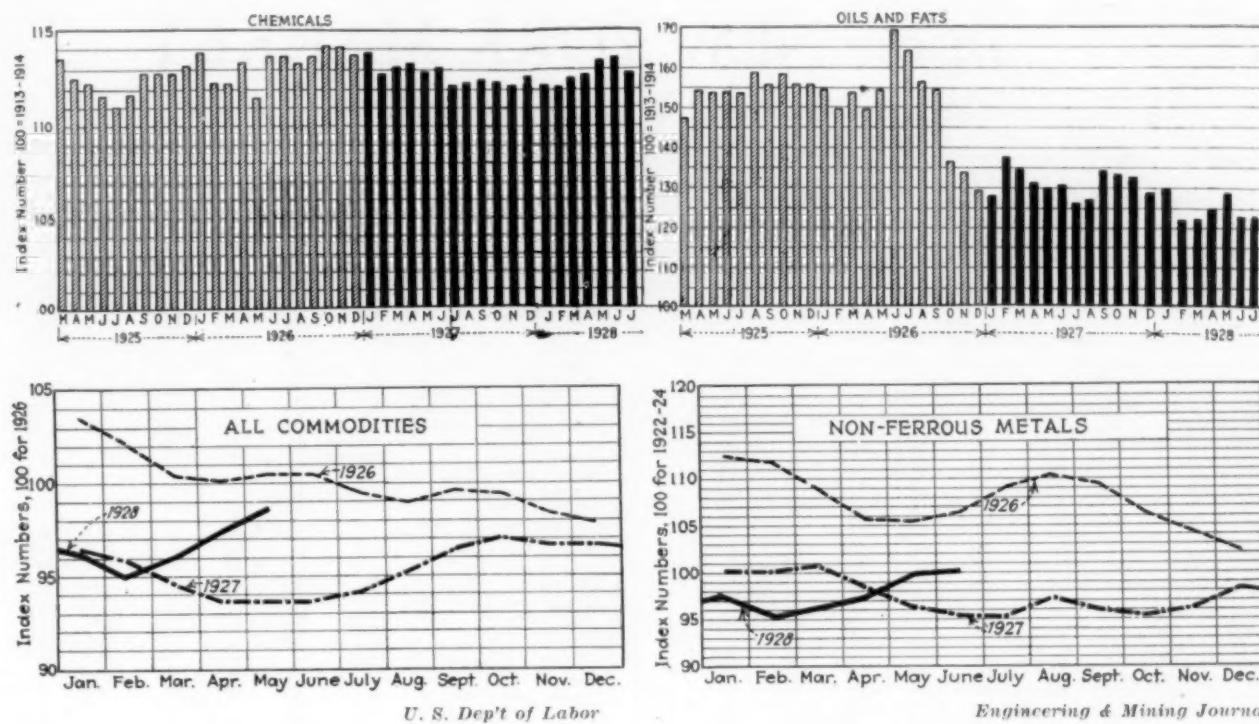
Imports of Chemicals

| | May | 1928 | 1927 |
|---------------------------------|------------|------------|------|
| Dead or creosote oil, gal..... | 11,265,442 | 14,276,498 | |
| Pyridine, lb..... | 16,007 | 16,705 | |
| Coal-tar acids, lb..... | 647,182 | 16,686 | |
| Coal-tar intermediates, lb..... | 92,763 | 163,762 | |
| Arsenic, white, lb..... | 2,826,609 | 6,510,541 | |
| Acid, citric, lb..... | 220 | 11,872 | |
| Acid, formic, lb..... | 106,644 | 235,947 | |
| Acid, oxalic, lb..... | 76,393 | 207,544 | |
| Acid, sulphuric, lb..... | 3,067,995 | 6,264,996 | |
| Acid, tartaric, lb..... | 37,520 | 187,488 | |
| Ammonium chloride, lb..... | 477,937 | 1,064,575 | |
| Ammonium nitrate, lb..... | 1,273,548 | 1,391,725 | |
| Barium compounds, lb..... | 362,587 | 1,779,549 | |
| Calcium carbide, lb..... | 126,176 | 377,510 | |
| Cobalt oxide, lb..... | 37,905 | 45,250 | |
| Copper sulphate, lb..... | 14,490 | 60,785 | |
| Bleaching powder, lb..... | 204,548 | 261,026 | |
| Glycerine, crude, lb..... | 165,328 | 999,288 | |
| Glycerine, ref., lb..... | 10,227 | 1,197,304 | |
| Iodine, crude, lb..... | 70,627 | 87,398 | |
| Magnesium compounds, lb..... | 1,844,169 | 1,728,188 | |
| Potassium cyanide, lb..... | 11,903 | 13,338 | |
| Potassium carbonate, lb..... | 1,360,684 | 1,227,863 | |
| Caustic potash, lb..... | 912,290 | 1,152,106 | |
| Cream of tartar, lb..... | ..... | 33,246 | |
| Potassium chlorate, lb..... | 1,036,436 | 1,025,422 | |
| Sodium cyanide, lb..... | 4,056,600 | 3,000,546 | |
| Sodium ferrocyanide, lb..... | 221,972 | 135,178 | |
| Sodium nitrite, lb..... | 11,512 | 47,491 | |
| Sodium nitrate, ton..... | 113,722 | 49,621 | |
| Sulphate of ammonia, ton..... | 2,479 | 186 | |

Exports of Chemicals

| | May | 1928 | 1927 |
|-------------------------------|------------|-----------|------|
| Benzol, gal..... | 3,435,849 | 1,885,821 | |
| Acid, acetic, lb..... | 47,056 | ..... |  |
| Acid, sulphuric, lb..... | 515,617 | 929,771 | |
| Other acids, lb..... | 447,199 | 471,215 | |
| Methanol, gal..... | 98,763 | 22,863 | |
| Glycerin, lb..... | 235,035 | 20,829 | |
| Formaldehyde, lb..... | 207,170 | 229,741 | |
| Ammonium compounds, lb..... | 261,020 | 396,019 | |
| Aluminum sulphate, lb..... | 3,539,486 | 3,380,777 | |
| Acetate of lime, lb..... | 1,152,256 | 1,581,661 | |
| Calcium carbide, lb..... | 180,253 | 337,586 | |
| Bleaching powder, lb..... | 4,476,366 | 828,442 | |
| Copper sulphate, lb..... | 1,106,309 | 328,715 | |
| Potassium compounds, lb..... | 5,595,855 | 284,415 | |
| Sodium bichromate, lb..... | 1,002,243 | 911,935 | |
| Sodium cyanide, lb..... | 81,681 | 137,455 | |
| Borax, lb..... | 17,642,270 | 4,600,459 | |
| Sodium carbonate, lb..... | 5,973,038 | 5,491,957 | |
| Sodium silicate, lb..... | 5,711,892 | 4,918,804 | |
| Caustic soda, lb..... | 1,402,154 | 9,284,047 | |
| Sodium bicarbonate, lb..... | 2,251,761 | 1,811,566 | |
| Sulphate of ammonia, ton..... | 9,120 | 17,386 | |
| Sulphur, ton..... | 80,644 | 135,149 | |

CHEM. & MET. Weighted Indexes of PRICES



Decline in Consuming Demand Lowers Prices for Chemicals

SLOWER call from important consuming industries has created an easier tone in the markets for sulphate of ammonia and nitrate of soda. Seasonal conditions also have been apparent in reduced buying of heavy chemicals and, in some cases, this has brought out shading of prices. As a rule, however, basic chemicals have undergone no quotable change and views that stock accumulations would develop keen selling pressure have not been borne out.

Attention has been drawn to aqua ammonia because of the strength in prices. Production of this chemical has been in close harmony with consumption and some sellers are reported to be sold ahead for the present. This condition, apparently, is more important in the spot market than for later deliveries as reports have been current to the effect

that contract buyers will be accommodated at former price levels.

Wood distillation chemicals also have been featured by a firm price tone. Quotations for acetone have been marked up and strong markets are reported for methanol and formaldehyde. Confidence in the stability of the methanol market is shaken by reports that production from a new source is to come on the market. According to this report, the new output is based on methane and oxygen obtained from mineral oil with a very low production cost. Incidentally, it is stated that producers of synthetic methanol already operating are able to produce in quantities sufficient to take care of domestic requirements.

Competitive conditions have continued throughout the month in the case of borax and boric acid. The low prices quoted are accentuated by the fact that they include delivery to consumer's plants.

CROP reports are looming up as important price factors in the market for vegetable oils. Of prime importance was the report that cotton acreage had been increased over that of last year. As fertilizer was used, in the cotton-growing states, to a larger extent than was the case last year, the yield per acre should be higher and result in an increase in the cottonseed supply larger than is indicated by the gain in

acreage. As stocks of lard are unusually large and the carryover of cottonseed oil is above normal, conditions point to relatively low price for vegetable oils in the coming season.

The report on flaxseed acreage is less favorable as it placed prospective yield considerably below the amount harvested last year. While world conditions are important in influencing values for flaxseed and linseed oil, variations in the domestic seed supply are not to be disregarded and a reduction in acreage in the Northwest forms a foundation for a higher price structure for seed and oil. Linseed oil, therefore, and, to a lesser extent, corn oil differ from other vegetable oils as far as future price trends are concerned.

As cottonseed oil comes into competition with animal fats, it exerts an influence on prices for tallow, lard, and similar products. Naturally this influence now is regarded as of bearish import especially in view of the record stocks of lard which are in store and which depress lard compound trade.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

| | |
|------------|--------|
| This month | 112.80 |
| Last month | 113.06 |
| July, 1927 | 112.23 |
| July, 1926 | 113.33 |

Slightly lower price levels ruled for chemicals during the month. Sulphate of ammonia sold at lower figures as did nitrate of soda. Ammonia was firmer with the alkalies barely steady. Borax has been under selling pressure and low prices have been accepted in boric acid sales.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

| | |
|------------|--------|
| This month | 122.63 |
| Last month | 122.76 |
| July, 1927 | 126.20 |
| July, 1926 | 164.71 |

Very little net change was reported in the position of crude cottonseed oil but lower prices were effective in the case of linseed, peanut, and oleo oils. Corn oil was firmer with palm, coconut, soya bean, and china wood oils practically unchanged.

CURRENT PRICES

in the NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 16.

Industrial Chemicals

| | Current Price | Last Month | Last Year | Current Price | Last Month | Last Year | |
|---|-----------------|-----------------|-----------------|---|---------------|---------------|---------------|
| Acetone, drums.....lb. | \$0.14 - \$0.14 | \$0.13 - \$0.14 | \$0.12 - \$0.13 | Orange mineral, cask.....lb. | \$0.112 - . | \$0.112 - . | \$0.112 - . |
| Acid, acetic, 28%, bbl. ....ewt. | 3.38 - 3.63 | 3.38 - 3.63 | 3.38 - 3.63 | Phosphorus, red, cases.....lb. | .62 - .65 | .62 - .65 | .62 - .65 |
| Boric, bbl. ....lb. | .064 - .07 | .064 - .07 | .064 - .084 | Yellow, cases.....lb. | .32 - .33 | .32 - .34 | .32 - .33 |
| Citric, kegs.....lb. | .46 - .47 | .46 - .47 | .444 - .45 | Potassium bichromate, cases, lb. | .084 - .084 | .084 - .084 | .084 - .084 |
| Formic, bbl. ....lb. | .11 - .12 | .11 - .12 | .104 - .11 | Carbonate, 80-85%, calc., cask, lb. | .051 - .06 | .051 - .06 | .051 - .06 |
| Gaoline, tech., bbl. ....lb. | .50 - .55 | .50 - .55 | .50 - .55 | Chlorate, powd. ....lb. | .08 - .084 | .08 - .084 | .08 - .09 |
| Hydrofluorite, 30% carb. ....lb. | .06 - .07 | .06 - .07 | .06 - .07 | Cyanide, ca. ....lb. | .51 - .53 | .51 - .53 | .55 - .57 |
| Lactic, 44%, tech., light, bbl, lb. | .12 - .124 | .12 - .124 | .13 - .14 | First sorts, cask.....lb. | .084 - .09 | .084 - .09 | .084 - .09 |
| 22%, tech., light, bbl, lb. | .054 - .06 | .052 - .06 | .064 - .07 | Hydroxide(c'stic potash)dr,lb. | .074 - .074 | .074 - .074 | .074 - .074 |
| Muriatic, 18%, tanks.....cwt. | .85 - .90 | .85 - .90 | .85 - .90 | Muriate, 80% bgs.....ton | 36.40 - . | 36.40 - . | 36.40 - . |
| Nitric, 36%, carboys.....lb. | .05 - .054 | .05 - .054 | .05 - .054 | Nitrate, bbl. ....lb. | .06 - .064 | .06 - .064 | .06 - .071 |
| Oleum, tanks, wks.....ton | 18.00 - 20.00 | 18.00 - 20.00 | 18.00 - 20.00 | Permanganate, drums.....lb. | .15 - .16 | .15 - .16 | .14 - .15 |
| Oxalic, crystals, bbl. ....lb. | .11 - .114 | .11 - .114 | .11 - .114 | Prussiate, yellow, cases, lb. | .171 - .19 | .171 - .19 | .181 - .19 |
| Phosphoric, tech., c'by's. ....lb. | .084 - .09 | .084 - .09 | .084 - .09 | Sal ammoniac, white, cases, lb. | .047 - .05 | .047 - .05 | .051 - .06 |
| Sulphuric, 60%, tanks.....ton | 11.00 - 11.50 | 11.00 - 11.50 | 10.50 - 11.00 | Salsoda, bbl. ....cwt. | .90 - .95 | .90 - .95 | .90 - .95 |
| Tannic, tech., bbl. ....lb. | .35 - .40 | .35 - .40 | .35 - .40 | Salt cake, bulk.....ton | 14.00 - 17.00 | 14.00 - 17.00 | 17.00 - 19.00 |
| Tartaric, powd., bbl. ....lb. | .38 - .384 | .38 - .384 | .37 - .374 | Soda ash, light, 58%, bags, contract.....ewt. | 1.32 - . | 1.32 - . | 1.32 - . |
| Tungstic, bbl. ....lb. | 1.00 - 1.20 | 1.00 - 1.20 | 1.00 - 1.20 | Dense, bags, contract.....ewt. | 1.35 - . | 1.35 - . | 1.374 - . |
| Alcohol, ethyl, 190 off., bbl, gal. | 2.704 - 2.75 | 2.704 - 2.75 | 3.75 - 4.00 | Soda, caustic, 76%, solid, drums, contract.....ewt. | 2.80 - 3.00 | 2.80 - 3.00 | 3.00 - 3.10 |
| Alcohol, Butyl, dr. ....lb. | .184 - .19 | .184 - .19 | .194 - .20 | Acetate, works, bbl. ....lb. | .051 - .06 | .051 - .064 | .044 - .05 |
| Denatured, 190 proof | | | | Bicarbonate, bbl. ....ewt. | 2.00 - 2.25 | 2.00 - 2.25 | 2.00 - 2.25 |
| No. 1 special dr. ....gal. | .45 - . | .45 - . | .464 - . | Bichromate, casks.....lb. | .07 - .074 | .07 - .074 | .061 - .061 |
| No. 3, 189 proof, dr. ....gal. | .44 - . | .44 - . | .44 - . | Bisulphite, bulk.....ton | 3.00 - 3.50 | 3.00 - 3.50 | 5.00 - 5.50 |
| Alum, ammonia, lump, bbl. ....lb. | .034 - .04 | .034 - .04 | .034 - .04 | Bisulphite, bbl. ....lb. | .03 - .034 | .03 - .034 | .03 - .04 |
| Chrome, bbl. ....lb. | .054 - .051 | .054 - .051 | .054 - .051 | Chlorate, kegs.....lb. | .051 - .06 | .051 - .06 | .061 - .064 |
| Potash, lump, bbl. ....lb. | .024 - .034 | .024 - .034 | .024 - .034 | Chloride, tech., ton | 12.00 - 14.75 | 12.00 - 14.75 | 12.00 - 14.00 |
| Aluminum sulphate, com., bags.....ewt. | 1.40 - 1.45 | 1.40 - 1.45 | 1.40 - 1.45 | Cyanide, cases, dom. ....lb. | .18 - .22 | .18 - .22 | .18 - .22 |
| Iron free, bg. ....ewt. | 2.00 - 2.10 | 2.00 - 2.10 | 2.00 - 2.10 | Fluoride, bbl. ....lb. | .084 - .094 | .084 - .094 | .084 - .09 |
| Aqua ammonia, 26%, drums, lb. ....lb. | .034 - .04 | .034 - .04 | .024 - .03 | Hyposulphite, bbl. ....lb. | 2.50 - 3.00 | 2.50 - 3.00 | 2.50 - 3.00 |
| Ammonia, anhydrous, cyl. ....lb. | .134 - . | .134 - . | .11 - .13 | Nitrate, bags, ewt. | 2.224 - . | 2.224 - . | 2.50 - . |
| Ammonium carbonate, powd., tech., casks.....lb. | .104 - .14 | .104 - .14 | .104 - .14 | Nitrate, casks.....lb. | .074 - .08 | .074 - .08 | .08 - .084 |
| Sulphate, wks.....ewt. | 2.35 - . | 2.40 - . | 2.25 - . | Phosphate, dibasic, bbl. ....lb. | .03 - .034 | .03 - .034 | .031 - .031 |
| Amylacetate, tech., drums.....gal. | 1.75 - 2.00 | 1.75 - 2.00 | 2.15 - 2.20 | Prussiate, yel, drums.....lb. | .11 - .12 | .11 - .12 | .12 - .124 |
| Antimony Oxide, bbl. ....lb. | .12 - .124 | .12 - .124 | .16 - .164 | Silicate (30%, drums) ....ewt. | .75 - 1.15 | .75 - 1.15 | .75 - 1.15 |
| Arsenic, white, powd., bbl. ....lb. | .04 - .044 | .04 - .044 | .034 - .044 | Sulphide, fused, 60-62%, dr,lb. | .024 - .034 | .024 - .03 | .034 - .04 |
| Red, powd., kegs.....lb. | .09 - .10 | .09 - .10 | .081 - .09 | Sulphite, crys., bbl. ....lb. | .024 - .03 | .024 - .03 | .024 - .03 |
| Barium carbonate, bbl. ....ton | 57.50 - 60.00 | 57.50 - 60.00 | 50.00 - 52.00 | Strontrium nitrate, bbl. ....lb. | .09 - .094 | .09 - .094 | .084 - .09 |
| Chloride, bbl. ....ton | 57.00 - 58.00 | 55.00 - . | 58.00 - 60.00 | Sulphur, crude at mine, bulk, ton | 18.00 - . | 18.00 - . | 18.00 - . |
| Nitrate, snak. ....lb. | .074 - .08 | .074 - .08 | .08 - .084 | Chloride, dr. ....lb. | .04 - .05 | .04 - .05 | .05 - .054 |
| Blanc fixe, dry, bbl. ....lb. | .034 - .04 | .034 - .04 | .04 - .044 | Dioxide, cyl. ....lb. | .09 - .10 | .09 - .10 | .09 - .10 |
| Bleaching powder, f.o.b., wks., drums.....ewt. | 2.00 - 2.10 | 2.00 - 2.10 | 2.00 - 2.10 | Flour, bag, ewt. | 2.70 - 3.00 | 2.70 - 3.00 | 2.70 - 3.00 |
| Borax, bbl. ....lb. | .024 - .03 | .024 - .03 | .044 - .044 | Tin biechioride, bbl. ....lb. | .141 - . | .15 - . | .193 - . |
| Bronine, es. ....lb. | .45 - .47 | .45 - .47 | .45 - .47 | Oxide, bbl. ....lb. | .53 - . | .56 - . | .69 - . |
| Calcium acetate, bags.....ewt. | 3.50 - . | 3.50 - . | 3.50 - . | Crystals, bbl. ....lb. | .36 - . | .374 - . | .47 - . |
| Arenate, dr. ....lb. | .064 - .07 | .064 - .07 | .074 - .08 | Zinc chloride, gran., bbl. ....lb. | .064 - .064 | .064 - .064 | .064 - .064 |
| Carbide druma. ....lb. | .05 - .06 | .05 - .06 | .05 - .06 | Carbonate, bbl. ....lb. | .10 - .11 | .10 - .10 | .10 - .11 |
| Chloride, fused, dr., wks. ....ton | 20.00 - . | 20.00 - . | 21.00 - . | Cyanide, dr. ....lb. | .40 - .41 | .40 - .41 | .40 - .41 |
| Phosphate, bbl. ....lb. | .07 - .074 | .07 - .074 | .07 - .074 | Dust, bbl. ....lb. | .084 - .09 | .084 - .09 | .094 - .10 |
| Carbon bisulphide, drums.....lb. | .05 - .06 | .05 - .06 | .054 - .06 | Zinc oxide, lead free, bag. ....lb. | .064 - .064 | .064 - .064 | .064 - .064 |
| Tetrachloride drums.....lb. | .064 - .07 | .064 - .07 | .064 - .07 | 3% lead sulphate, bags, ....ewt. | .061 - . | .061 - . | .061 - . |
| Chlorine, liquid, tanks, wks. ....lb. | .034 - .044 | .034 - .044 | .04 - .044 | Sulphate, bbl. ....ewt. | 2.75 - 3.00 | 2.75 - 3.00 | 2.75 - 3.00 |
| Cylinders.....lb. | .054 - .08 | .054 - .08 | .054 - .08 | | | | |
| Cobalt oxide, cans.....lb. | 2.10 - 2.20 | 2.10 - 2.20 | 2.10 - 2.25 | | | | |
| Copperas, bgs., f.o.b. wks. ....ton | 16.00 - 17.00 | 16.00 - 17.00 | 14.00 - 17.00 | | | | |
| Copper carbonate, bbl. ....lb. | .164 - .174 | .164 - .174 | .17 - .18 | | | | |
| Cyanide, tech., bbl. ....lb. | .49 - .50 | .49 - .50 | .49 - .50 | | | | |
| Sulphate, bbl. ....ewt. | 5.30 - 5.50 | 5.30 - 5.50 | 4.90 - 5.00 | | | | |
| Cream of tartar, bbl. ....lb. | .264 - .27 | .254 - .27 | .264 - .27 | | | | |
| Diethylene glycol, dr. ....lb. | .10 - .15 | .10 - .15 | .10 - .15 | | | | |
| Epsom salt, dom., tech., bbl, ewt. | 1.72 - 2.15 | 1.72 - 2.00 | 1.72 - 2.00 | | | | |
| Imp., tech., bags, ewt. | 1.15 - 1.23 | 1.15 - 1.25 | 1.35 - 1.40 | | | | |
| Ethyl acetate, 85%, drums.....gal. | .74 - .76 | .74 - .76 | .74 - .76 | | | | |
| Formaldehyde, 40%, bbl. ....lb. | .074 - .084 | .074 - .084 | .114 - .114 | | | | |
| Furfural, dr. ....lb. | .15 - .174 | .15 - .174 | .15 - .17 | | | | |
| Fuel oil, crude, drums.....gal. | 1.30 - 1.40 | 1.30 - 1.40 | 1.40 - 1.50 | | | | |
| Refined, dr. ....gal. | 2.50 - 3.00 | 2.50 - 3.00 | 2.50 - 3.00 | | | | |
| Glauber salt, bags, ewt. | 1.10 - 1.20 | 1.10 - 1.20 | 1.00 - 1.10 | | | | |
| Glycerine, e.p., drums, extra, lb. | .15 - .154 | .15 - .154 | .244 - .25 | | | | |
| Lead | | | | | | | |
| White, basic carbonate, dry, cases.....lb. | .084 - . | .084 - . | .09 - . | | | | |
| White, basic sulphate, ack, lb. | .074 - . | .074 - . | .084 - . | | | | |
| Red, dry, sek. ....lb. | .094 - . | .094 - . | .094 - . | | | | |
| Lead acetate, white crys., bbl, lb. | .13 - .134 | .13 - .134 | .13 - .134 | | | | |
| Lead arsenate, powd., bbl. ....lb. | .13 - .14 | .13 - .14 | .12 - .13 | | | | |
| Lime, chem., bulk.....ton | 8.50 - . | 8.50 - . | 8.50 - . | | | | |
| Lithopone, bags.....lb. | .084 - . | .084 - . | .084 - . | | | | |
| Magnesium carb., tech., bags, lb. | .064 - .07 | .064 - .07 | .074 - .08 | | | | |
| Methanol, 95%, dr. ....gal. | .48 - . | .48 - . | .45 - .45 | | | | |
| 97%, dr. ....gal. | .48 - . | .48 - . | .45 - .47 | | | | |
| Nickel salt, double, bbl. ....lb. | .10 - .104 | .10 - .104 | .10 - .10 | | | | |
| Single, bbl. ....lb. | .104 - .11 | .104 - .11 | .104 - .114 | | | | |

Coal-Tar Products

| | Current Price | Last Month | Last Year |
|-------------------------------------|-----------------|-----------------|-----------------|
| Alpha-naphthol, crude, bbl. ....lb. | \$0.60 - \$0.65 | \$0.60 - \$0.65 | \$0.60 - \$0.62 |
| Refined, bbl. ....lb. | .85 - .90 | .85 - .90 | .85 - .90 |
| Alpha-naphthylamine, bbl. ....lb. | .35 - .36 | .35 - .36 | .35 - .36 |
| Aniline oil, drums, extra.....lb. | .15 - .16 | .15 - .16 | .15 - .16 |
| Aniline salts, bbl. ....lb. | .24 - .25 | .24 - .25 | .24 - .25 |
| Anthracene, 80%, drums....lb. | .60 - .65 | .60 - .65 | .60 - .65 |

Coal Tar Products (Continued)

| | Current Price | Last Month | Last Year |
|------------------------------------|---------------|-------------|-------------|
| Benzaldehyde, U.S.P., dr. | 1.15 - 1.25 | 1.15 - 1.35 | 1.15 - 1.25 |
| Benzidine base, bbl. | .70 - .72 | .70 - .75 | .70 - .72 |
| Benzoic acid, U.S.P., kgs. | .58 - .60 | .58 - .60 | .58 - .60 |
| Benzyl chloride, tech. | .25 - .26 | .25 - .26 | .25 - .26 |
| Benzol, 90%, tanks, works. | .22 - .23 | .22 - .23 | .24 - .25 |
| Beta-naphthol, tech., drums | .22 - .24 | .22 - .24 | .22 - .24 |
| Cresol, U.S.P., dr. | .18 - .20 | .18 - .20 | .18 - .20 |
| Cresylic acid, 97%, dr., wks gal. | .73 - .75 | .73 - .75 | .61 - .62 |
| Diethylamine, dr. | .58 - .60 | .58 - .60 | .58 - .60 |
| Dinitrophenol, bbl. | .31 - .35 | .31 - .33 | .31 - .35 |
| Dinitrotoluene, bbl. | .17 - .18 | .17 - .18 | .17 - .18 |
| Dip oil, 25% dr. | .28 - .30 | .28 - .30 | .28 - .30 |
| Diphenylamine, bbl. | .45 - .47 | .45 - .47 | .45 - .47 |
| H-acid, bbl. | .63 - .65 | .63 - .65 | .63 - .65 |
| Naphthalene, flake, bbl. | .05 - .06 | .05 - .06 | .04 - .05 |
| Nitrobenzene, dr. | .084 - .10 | .084 - .10 | .09 - .10 |
| Para-nitroaniline, bbl. | .52 - .53 | .52 - .53 | .52 - .53 |
| Para-nitrotoluine, bbl. | .28 - .32 | .28 - .32 | .28 - .32 |
| Phenol, U.S.P., drums | .15 - .17 | .15 - .17 | .17 - .18 |
| Picric acid, bbl. | .30 - .40 | .30 - .40 | .25 - .26 |
| Pyridine, dr. | 1.35 - 1.50 | 1.35 - 1.50 | 3.00 - .30 |
| R-salt, bbl. | .47 - .50 | .47 - .50 | .47 - .50 |
| Resorcinol, tech., kegs. | 1.30 - 1.35 | 1.30 - 1.35 | 1.30 - 1.40 |
| Salicylic acid, tech., bbl. | .30 - .32 | .30 - .32 | .30 - .32 |
| Solvent naphtha, w.w., tanks, gal. | .35 - .37 | .35 - .37 | .35 - .37 |
| Tolidine, bbl. | .95 - .95 | .95 - .96 | .95 - .96 |
| Toluene, tanks, works. | .35 - .37 | .35 - .37 | .35 - .37 |
| Xylene, com., tanks | .36 - .41 | .36 - .41 | .36 - .40 |

Miscellaneous

| | Current Price | Last Month | Last Year |
|------------------------------------|-----------------|-----------------|-----------------|
| Barytes, grd., white, bbl. | \$23.00-\$25.00 | \$23.00-\$25.00 | \$23.00-\$25.00 |
| Casein, tech., bbl. | .15 - .16 | .15 - .16 | .17 - .18 |
| China clay, dom., f.o.b. mine ton | 10.00 - 20.00 | 10.00 - 20.00 | 10.00 - 20.00 |
| Dry colors: | | | |
| Carbon black (wks.), bbl. | .06 - .07 | .06 - .07 | .06 - .07 |
| Prussian blue, bbl. | .31 - .33 | .31 - .33 | .33 - .34 |
| Ultrameric blue, bbl. | .08 - .10 | .08 - .10 | .08 - .10 |
| Chrome green, bbl. | .27 - .31 | .27 - .30 | .27 - .30 |
| Carmine red, tina. | 5.25 - 5.50 | 5.25 - 5.50 | 5.50 - 5.75 |
| Para toner. | .60 - .70 | .60 - .70 | .80 - .90 |
| Vermilion, English, bbl. | 1.80 - 1.85 | 1.80 - 1.85 | 1.80 - 1.85 |
| Chrome yellow, C. P., bbl. | 1.54 - .16 | 1.54 - .16 | .17 - .18 |
| Feldspar, No. 1 (f.o.b. N. C.) ton | 5.75 - 7.00 | 5.75 - 7.00 | 5.75 - 7.00 |
| Graphite, Ceylon, lump, bbl. | .08 - .084 | .08 - .084 | .08 - .09 |
| Gun copal, Congo, bags. | .074 - .08 | .074 - .08 | .091 - .10 |
| Manila, bags. | .15 - .18 | .15 - .16 | .15 - .18 |
| Damar, Batavia, cases. | .22 - .23 | .22 - .23 | .25 - .25 |
| Kauri, No. 1 cases. | .48 - .53 | .48 - .53 | .55 - .57 |
| Kieselguhr (f.o.b. N. Y.) | 50.00 - 55.00 | 50.00 - 55.00 | 50.00 - 55.00 |
| Magnesite, calc. | 40.00 - .00 | 40.00 - .00 | 44.00 - .00 |
| Pumice stone, lump, bbl. | .05 - .07 | .05 - .08 | .05 - .07 |
| Imported, casks. | .03 - .40 | .03 - .40 | .03 - .35 |
| Rosin, H. | 9.85 - .00 | 9.00 - .00 | 10.00 - .00 |
| Turpentine. | .534 - .00 | .534 - .00 | .57 - .00 |
| Shellac, orange, fine, bags. | .52 - .54 | .52 - .54 | .52 - .53 |
| Bleached, bonedry, bags. | .54 - .56 | .54 - .56 | .59 - .61 |
| T. N. bags. | .45 - .46 | .45 - .46 | .40 - .45 |
| Sapadone (f.o.b. Vt.), bags, ton | 10.00 - 12.00 | 10.00 - 12.00 | 10.00 - 12.00 |
| Talc, 200 mesh (f.o.b. Vt.) | 9.50 - .00 | 9.50 - .00 | 10.50 - .00 |
| 300 mesh (f.o.b. Ga.) | 7.50 - 10.00 | 7.50 - 10.00 | 7.50 - 11.00 |
| 225 mesh (f.o.b. N. Y.) | 13.75 - .00 | 13.75 - .00 | 13.75 - .00 |

| | Current Price | Last Month | Last Year |
|------------------------|-----------------|-----------------|-----------------|
| Wax, Bayberry, bbl. | \$0.30 - \$0.32 | \$0.33 - \$0.34 | \$0.25 - \$0.26 |
| Beeswax, ref., light. | .41 - .42 | .41 - .42 | .45 - .46 |
| Candelilla, bags. | .23 - .24 | .24 - .25 | .33 - .34 |
| Carnauba, No. 1, bags. | .50 - .51 | .55 - .56 | .65 - .70 |
| Paraffine, crude | 105-110 m.p. | lb. .04 - .05 | lb. .04 - .05 |
| | | | |

Ferro-Alloys

| | Current Price | Last Month | Last Year |
|------------------------|-----------------|-----------------|---------------|
| Ferrotitanium, 15-18% | ton \$200.00 - | ton \$200.00 - | \$200.00 - |
| Ferromanganese, 78-82% | ton 105.00 - | ton 105.00 - | 90.00 - |
| Spiegelreisen, 19-21% | ton 32.00 - | ton 32.00 - | 36.00 - 37.00 |
| Ferrosilicon, 14-17% | ton 45.00 - | ton 45.00 - | - |
| Ferrotungsten, 70-80% | lb. .95 - .98 | lb. .95 - .98 | .95 - .98 |
| Ferro-uranium, 35-50% | lb. 4.50 - | lb. 4.50 - | 4.50 - |
| Ferrovanadium, 30-40% | lb. 3.15 - 3.75 | lb. 3.15 - 3.75 | 3.15 - 3.75 |

Non-Ferrous Metals

| | Current Price | Last Month | Last Year |
|---------------------------|-------------------|-------------------|---------------|
| Copper, electrolytic | lb. \$0.142 - | lb. \$0.142 - | \$0.12 - |
| Aluminum, 96-99% | lb. .24 - .26 | lb. .24 - .26 | .26 - .28 |
| Antimony, Chin. and Jap. | lb. .094 - | lb. .104 - | .12 - |
| Nickel, 99% | lb. .35 - | lb. .35 - | .35 - |
| Monel metal, blocks. | lb. .28 - | lb. .28 - | .32 - .33 |
| Tin, 5-ton lots, Straits. | lb. .464 - | lb. .488 - | .688 - |
| Lead, New York, spot. | lb. 6.20 - | lb. 6.30 - | 6.20 - |
| Zinc, New York, spot. | lb. 6.55 - | lb. 6.50 - | 6.57 - |
| Silver, commercial. | oz. .574 - | oz. .574 - | .574 - |
| Cadmium | lb. .60 - | lb. .60 - | .60 - |
| Bismuth, ton lots. | lb. 1.85 - 2.10 | lb. 1.85 - 2.00 | 2.20 - 2.25 |
| Cobalt | lb. 2.50 - | lb. 2.50 - | 2.50 - |
| Magnesium, ingots, 99% | lb. .98 - | lb. .98 - | .75 - .80 |
| Platinum, ref. | oz. 75.50 - 76.50 | oz. 75.50 - 76.50 | 86.00 - |
| Palladium, ref. | oz. 46.00 - 49.00 | oz. 46.00 - 49.00 | 59.00 - 63.00 |
| Mercury, flask. | 75 lb. 121.50 - | 75 lb. 123.00 - | 117.00 - |
| Tungsten powder. | lb. 1.05 - 1.15 | lb. 1.05 - | 1.05 - |

Ores and Semi-finished Products

| | Current Price | Last Month | Last Year |
|---|------------------------------|---------------------|-----------------|
| Bauxite, crushed, wks. | ton \$7.50 - \$8.00 | ton \$7.50 - \$8.50 | \$5.50 - \$8.75 |
| Chrome ore, c.f. post. | ton 22.00 - 24.00 | ton 22.00 - 24.00 | 22.00 - 23.00 |
| Coke, fdry., f.o.b. ovens. | ton 2.85 - 3.00 | ton 2.85 - 3.00 | 3.25 - 3.75 |
| Fluorspar, gravel, f.o.b. Ill. | ton 16.00 - | ton 16.00 - | 17.00 - |
| Ilmenite, 52% TiO ₂ , Va. | lb. .001 - .001 | lb. .001 - .001 | .001 - |
| Manganese ore, 50% Mn, c.f. Atlantic Ports | unit .36 - .38 | unit .36 - .38 | .36 - .38 |
| Molybdenite, 85% MoS ₂ per | lb. MoS ₂ , N. Y. | lb. .48 - .50 | .48 - .50 |
| Monazite, 6% of ThO ₂ . | ton 130.00 - | ton 130.00 - | 120.00 - |
| Pyrites, Span. fines, c.f., unit | unit .13 - | unit .13 - | .13 - |
| Rutile, 94-96% TiO ₂ . | lb. .11 - .13 | lb. .11 - .13 | .11 - .13 |
| Tungsten, scheelite, 60% WO ₃ and over. | unit 10.50 - 10.75 | unit 10.50 - 10.75 | 11.25 - 11.50 |
| Vanadium ore, per lb. V ₂ O ₅ . | lb. nom. | lb. nom. | 25 - 28 |
| Zircon, 99% | lb. .03 - | lb. .03 - | .03 - |

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Acetylene Gas Building, Core Building. — Chevrolet Motor Car Co., General Motors Bldg., Detroit, Mich., awarded contract for the construction of a group of buildings, including acetylene gas, core and foundry cleaning and oil storage buildings, tank pit, etc., at Saginaw, Mich., to Everett Winters, 1561 East Grand Blvd., Detroit, Mich. Estimated cost \$2,000,000.

Aluminum Foundry—Packard Motor Car Co., 1580 East Grand Blvd., Detroit, Mich., awarded contract for the construction of an aluminum foundry to Everett Winters Co., 1551 East Grand Blvd., Detroit, Mich. Estimated cost \$100,000.

Carbide Plant—Linde Air Products Corp., 121 East Washington St., Chicago, Ill., is having plans prepared for the construction of a carbide plant at Oklahoma City, Okla. Estimated cost \$100,000. Private plans.

Carbon Monoxide Detectors and Recorders—Alameda County, G. E. Gross, Clk., Oakland, Calif., will receive bids until July 30, for carbon monoxide detectors and recorders for Oakland-Alameda Estuary tube project. G. A. Posey, Courthouse, Oakland, Calif., is engineer.

Carbon Plant—Page Carbon Co., Page, Okla., is having preliminary plans prepared for the construction of a new carbon plant. Estimated cost \$75,000. Private plans.

Carborundum Factory—Carborundum Co., Buffalo Ave., Niagara Falls, N. Y., awarded contract for a 81 x 224 ft. factory to Laur & Mack, 1400 College Ave., Niagara Falls. Estimated cost \$225,000.

Cellaphane Factory—Dupont Cellaphane Co., River Road, Buffalo, N. Y., plans the construction of a cellaphane factory. DuPont Engineering Co., River Road, Buffalo, N. Y., is engineer.

Cement Plant—Monolith Portland Mid-West Co., Laramie, Wyo., plans the construction of a new cement plant including kiln, 343 ft. long and 11½ ft. in diameter. Estimated cost \$2,000,000.

Cement Plant—Portland Cement Corp., L. L. Griffiths, Pres., Ann Arbor, Mich., plans the construction of a cement plant at Pownal, Vt. Estimated cost \$40,000. Architect not selected.

Cement Plant Equipment—Terrell Bartlett Engrs., Calcasieu Bldg., San Antonio, Tex., Engrs., are receiving bids for cement plant equipment, etc. for Smith Bros. Properties Inc., J. W. Young, 431 South St. Marys St., San Antonio, Tex. Total estimated cost \$2,000,000.

Chemical Storage Building—Office of Supervising Architect, Treasury Dept., Washington, D. C., awarded contract for the construction of a chemical storage building at Quarantine Station, New York, N. Y. to M. Baragh, 60 Bergen St., Brooklyn, N. Y.

Chemistry Building—New Hampshire State College, Durham, N. H., will soon award contract for the construction of a 4 story, 58 x 154 ft. chemistry building. Estimated cost \$150,000. E. T. Huddleston, Durham, N. H., is architect.

Chromium Plating Factory—Koepen Metal Products Inc., 361 Manhattan Ave., Union City, N. J., plans the construction of a 2 story, 80 x 350 ft. chrome plating factory at Carlstadt, (br. Rutherford) N. J. Estimated cost \$60,000.

Cocoa Cola Plant—Crawford Johnson & Co. Inc., 508 South 22nd St., Birmingham, Ala., awarded contract for the construction of a cocoa cola plant at 11th St. between 33rd and 34th Aves. to South Ferro Concrete Co., 70 Ellis St. N.E., Atlanta, Ga. Estimated cost \$165,000.

Confectionery Factory—Euclid East 65th St. Co., I. W. Shenker, Secy. and Treas., Engineers Bldg., Cleveland, O., is having preliminary plans prepared for a 4 story, 68 x 100 ft. factory. Estimated cost \$80,000. Vraverman & Havermalt, Ulmer Bldg., Cleveland, O., are architects. McNally-Doyle Co., (confectionery manufacturers) lessee.

Confectionery Factory—The Ohio Confection Co., J. Friedman, Pres., 6110 Grand Ave., Cleveland, O., had plans prepared for a 3 story confectionery factory. Estimated cost \$75,000. R. H. Hinsdale, Erie Bldg., Cleveland, O., is architect.

Copper Products Factory—American Copper Products Corp., Bayway, Elizabeth, N. J., awarded contract for a 1 story, 105 x 400 ft. copper products factory at Laural St. and Amboy Ave. to Wigton Abbott Corp., 705 Park Ave., Plainfield, N. J. Estimated cost \$80,000.

Cotton Seed Oil Mill — Abilene Cotton Seed Oil Co., Abilene, Tex., is having plans prepared for the construction of a 1 story, 90 x 360 ft. cotton seed oil mill at Slaton, Tex. Estimated cost \$75,000. Private plans.

Cracking Still — Independent Oil & Gas Co., Kennedy Bldg., Tulsa, Okla., plans the construction of a cracking still for oil refinery at Okmulgee, Okla. Estimated cost \$60,000. Pritchard & Purtington, 543 Robinson Bldg., Tulsa, Okla., are engineers.

Dry Cleaning Plant — Langleys Ltd., 253 Spadina Rd., Hamilton, Ont., plans the construction of a dry cleaning plant on Main St. Estimated cost \$200,000. Architect and engineer not selected.

Dye Factory — H. H. Brown & Sons, 15th Ave., Paterson, N. J., awarded contract for a 1 story, 55 x 75 ft. dye factory at 4th Ave. and Railroad to J. Yorna, 1 Jane St., Paterson, N. J. Estimated cost \$40,000.

Fertilizer Plant — The Gulf Fertilizer Co., 766 Franklin St., Tampa, Fla., awarded contract for a 1 story, 161 x 306 ft. factory to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost \$165,000.

Fertilizer Plant Addition — Darling & Co., and Southern R.R., Mississippi Ave. and Alton St. East St. Louis, Ill., awarded contract for a 1 story addition to fertilizer plant to The Austin Co., Arcade Bldg., St. Louis, Mo. Estimated cost \$100,000.

Gas Plant — Lexington Thomasville Gas Co., N. H. Gellert, Pres., Lexington, N. C., plans the construction of a gas plant. Estimated cost \$175,000.

Gas Plant — Waterbury Gas Light Co., 83 Center St., Waterbury, Conn., awarded contract for the construction of a gas plant to U. G. I. Contg. Co., Broad and Arch Sts., Philadelphia, Pa. Estimated cost \$50,000.

Gasoline Plant — T. B. Slick Oil Co., Branwell Bldg., Oklahoma City, Okla., is having preliminary plans prepared for a natural gasoline plant at Maud, Okla. Estimated cost \$40,000. Private plans.

Gasoline Plants — Cushing Refining & Gasoline Co., Cushing, Okla., had plans prepared for the construction of natural gasoline absorption plants at Konowa, and Hazel, Okla. Estimated cost \$50,000 and \$60,000 respectively. Private plans.

Glass Plant — Pittsburgh Safety Glass Co., c/o Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., awarded contract for a 1 story plant at Creighton, Pa. to Mellon Stuart Co., Oliver Bldg., Pittsburgh, Pa. Estimated cost \$1,000,000.

Grinding Plant — North Carolina Feldspar Co., Bowditch, c/o J. S. Shinn, Concord, N. C., Pres., plans the construction of a grinding plant, 100 ton daily capacity at Bowditch, N. C.

Gypsum Factory — U. S. Gypsum Co., 300 West Adams St., Chicago, Ill., plans the construction of a gypsum factory at East Chicago, Ind.

Helium Plant — Dept. of Commerce, Bureau of Mines, Helium Division, Ft. Worth, Tex., will receive bids until July 20 for the construction of buildings, etc. in connection with helium plant at Amarillo, Tex.

Hosiery Mill and Dye Plant — Morten Davis Co., E. W. Morten, Jefferson Hotel, Dallas, will soon receive bids for a 1 story, 105 x 156 ft. hosiery mill, and 45 x 45 ft. dye plant on Maple Ave. Estimated cost \$55,000. W. S. Dunne, 306 Melba Bldg., Dallas, Tex., is architect.

Laboratory — Dept. of Mental Hygiene, Albany, N. Y., will receive bids in August for the construction of a laboratory for Kings Park State Hospital, Kings Park, L. I., N. Y.

Laboratory — General Motors Corp., General Motors Bldg., Detroit, Mich., awarded contract for an 11 story, 210 x 231 ft. laboratory at Second Blvd. between Baltimore and Milwaukee Sts., to Everett Winters Co., 1651 East Grand Blvd., Detroit, Mich. Estimated cost \$2,500,000.

Laboratories (Physics and Chemistry) — Bros. of Mary, Fresno, Calif., plans the construction of a group of college buildings including physics and chemistry laboratories, etc. at Thorne St. and McKinley Aves. Estimated cost \$175,000. Architect not selected.

Laboratory — Shell Oil Co., 200 Bush St., San Francisco, Calif., awarded contract for a 3 story laboratory at Santa Fe and Horton Sts., Emeryville, Calif., to G. Wagner, 181 South Park Ave., San Francisco, Calif. Estimated cost \$100,000.

Laboratory — R. T. Vanderbilt Co., W. H. Cope, 50 East 42nd St., New York, N. Y., awarded contract for a 3 story, 50 x 80 ft. laboratory on Winnfield St., East Norwalk, Conn. to Hewlett Co., 866 Main St., Bridgeport, Conn. Estimated cost \$55,000.

Laboratory, Etc. — Mississippi State College for Women, Columbus, Miss., is having preliminary plans prepared for the construction of a college including laboratory, etc. Estimated cost \$550,000. C. H. Lindsey, Lamar Life Bldg., Jackson, Miss., is architect.

Laboratory (Biological) — Kansas University, c/o Bd. of Regents, Lawrence, Kan., awarded contract for a 3 story, 50 x 116 and 44 x 94 ft. biological laboratory to P. D. Olmstead Construction Co., 2033 Tennessee St. Estimated cost \$200,000.

Laboratory (Research) — General Motors Corp., General Motors Bldg., Detroit, Mich., awarded contract for an 11 story, 210 x 255 ft. research laboratory at Cass and Baltimore Aves. to Everett Winters, 1651 East Grand Blvd., Detroit, Mich.

Laboratory Equipment — City of Cleveland, O., W. R. Hopkins, Mgr., will receive bids until July 25 for laboratory apparatus, laboratory chemicals and equipment for proposed new 2,500,000 southerly sewage treatment works.

Leather Factory — L. H. Hamel Leather Co., 117 Essex St., Haverhill, Mass., awarded contract for a 1 story, 60 x 180 ft. leather factory to John Roche, Haverhill, Mass. Estimated cost \$40,000 to \$50,000.

Leather Factory — J. Lichtman & Son, 241 Frelighsuisen Ave., Newark, N. J., awarded contract for a 4 story, 178 x 218 ft. leather factory at 306 Sherman Ave. to J. F. Mitchell Co., 30 Church St., New York, N. Y. Estimated cost \$350,000.

Malt House — Canada Malting Co., Montreal, Que., awarded contract for the construction of a malt house, 1,000,000 bu. capacity to MacDonald Engineering Co. of Canada, Ltd., Canadian Pacific Ry. Bldg., Toronto, Ont.

Malt Plant — Canada Malting Co., Royal Bank Bldg., Toronto, Ont., awarded contract for superstructure of a 4 story, 150 x 200 ft. malting plant and 80 x 190 ft. grain elevator to MacDonald Engineering Co. Ltd., 434 St. Francois Xavier St., Montreal, Que. Estimated cost \$500,000.

Milk Condensery — Page Milk Co., Merrill, Wis., plans the construction of a milk condensery at Marshall, Mo. Estimated cost \$250,000. Private plans.

Ore Washing Plant — Georgia Manganese & Iron Co., Atlanta, Ga., plans the construction of a plant for hydraulic washing of ore at Cartersville, Ga. Estimated cost \$250,000. Perin & Marshall, 40 West 40th St., New York, New York are engineers.

Oxygen and Acetylene Plants — Union Carbide & Carbon Corp., 30 East 42nd St., New York, is having preliminary plans prepared for the construction of an oxygen and acetylene plant at Byrne Ave. and Floyd St., Louisville, Ky. Estimated cost \$150,000. Private plans.

Paint Factory — United Color & Pigment Co., Evergreen Ave., Newark, N. J., awarded contract for a 1 story, 70 x 120 ft. paint factory on McClellan St. to Enstic Bros., 111 Academy St., Newark, N. J. Estimated cost \$40,000.

Paint and Varnish Factory — Arco Co. Ltd., 640 Euclid Ave., Cleveland, O., plans the construction of a paint and varnish factory at Mount Dennis, Ont. Estimated cost \$100,000.

Paint and Varnish Factory — The Ferbert-Schorndorfer Co., A. J. Ferbert, Pres., 12815 Elmwood St., Cleveland, O., plans the construction of addition to paint and varnish factory. Estimated cost \$60,000. Architect not selected.

Paints — Quartermaster, Langley Field, Va., will receive bids until July 19 for 1000 gal. lithopone paint, 300 gal. white paint and 600 gal. chrome green paint.

Paints — U. S. Engineer Office, Cincinnati, O., will receive bids until July 19 for varnish, bronze paint, aluminum paint, colors in oil, linseed oil, etc.

Paper Mill Addition — National Paper Products Co., ft. Main St., Seattle, Wash., plans the construction of an additional

second unit of kraft paper mill at Port Townsend, Wash.

Pasteurizing Plant — Peak Products Co., c/o C. H. Ziegler, 75 Montgomery St., Jersey City, N. J., will soon award contract for a 2 story, 80 x 180 ft. pasteurizing plant at Monmouth St. Estimated cost \$100,000.

Petroleum Plant — Asiatic Petroleum Co., 65 Broadway, New York, N. Y., has acquired 46 acres of land at Fairfield, (sta. Baltimore) Md., and plans the construction of a plant including asphalt plant, fuel oil storage tanks, etc. Estimated cost \$1,000,000.

Pottery Plant Addition — Kohler Co., Kohler, Wis., awarded contract for a 1 story, 125 x 500 ft. addition to pottery plant to Inmel Construction Co., Dona Bldg., Fon du Lac, Wisc.

Pulp and Paper Mill — International Paper Co., 100 East 42nd St., New York, N. Y., had plans prepared for the construction of a pulp and paper mill, 250 ton daily capacity at Chaleaur Bay, N. B. Estimated cost approximately \$6,500,000. Power to be supplied by subsidiary St. John River Power Co., also plans a mill in Ontario, 200 to 300 ton capacity, \$6,500,000.

Rayon Mill — The Viscose Co., Marcus Hook, Pa., awarded contract for several factory buildings at Meadville, Pa., to J. P. Pettyjohn Co., Lynchburg, Va. Estimated cost \$1,000,000.

Refinery — Corn Products Refining Co., North Kansas City, Mo., will build a 1 story refinery by day labor. Estimated cost \$150,000. Private plans.

Refinery — Amarillo Producers & Refiners Cor., J. W. Warthar, Amarillo, Tex., will build a refinery, 3,000 bbl. capacity at Pyote, Tex. Estimated cost \$150,000.

Refinery — Gulf Refining Co., 21 State St., New York, N. Y., is having preliminary plans prepared for a new refinery, storage and distribution plant at Mariners Harbor, Staten Island, N. Y., comprising nine units with power house, machine shop, etc. Facilities will be provided for handling crude oil from seagoing tankers, including pumping machinery, etc. Estimated total cost approximately \$20,000,000. W. M. Braybrooks is general manager.

Refinery (Oil) — Texas-Mexican Oil & Refining Co., Laredo, plans extensions and improvements to oil refinery to increase the capacity. Estimated cost \$150,000 to \$250,000. Machinery will be required.

Refinery (Oil) — Toukawa Petroleum Co., Toukawa, Okla., is having plans prepared for two new cracking stills to replace part of oil refinery recently destroyed by fire. Estimated cost \$65,000. Private plans.

Rubber Factory — Aetna Rubber Co., S. T. Campbell, Pres. and Gen. Mgr., 815 East 79th St., Cleveland, O., had plans prepared for three 1 story factory buildings at Ashtabula, O. Estimated cost \$100,000. Private plans.

Rubber Factory — Panco Rubber Co., F. Bernstein, Pres., 31 Highland Ave., Chelsea, Mass., is having revised plans prepared for a 2 story 90 x 100 ft. addition to rubber factory. Schein & Levine, 448 Broadway, Chelsea, Mass., are architects. Former bids rejected.

Silk Mill — Frank & Sons, Inc., North Bergen, N. J., had plans prepared for the construction of a silk mill at Charlottesville, Va. Estimated cost \$65,000.

Silos — Great Lakes Portland Cement Co., Marine Trust Bldg., Buffalo, N. Y., will soon award contract for the construction of eight concrete silos, 25 and 40 ft. inside and 100 ft. high on Riverbed Ave., Cleveland, O. Private plans.

Smelter Plant, etc. — Electro-Sideurgical de Valdivia, Valparaiso, Chile, awarded contract for the design, construction and operation of a 30,000 hp. power plant on Valdivia Lake in Andes Mts., also rebuilding plant at Port Corral for electric smelting, 100,000 ton annual capacity to J. G. White Engineering Co., 43 Exchange Pl., New York, N. Y. Estimated cost approximately \$6,000,000. Ore will be supplied from Bethlehem Steel Corp.'s mines at Tofo.

Smelter Plant — International Nickel Co., 67 Wall St., New York, N. Y., awarded contract for the construction of a smelter plant at Copper Cliff, Sudbury, Ont. to Fraser Brace Ltd., 83 Craig St. W., Montreal, Que. Estimated cost \$1,000,000.

Talc Factory — National Talc Ltd., plans the construction of a manufacturing plant to utilize the raw talc deposits of the Rocky Mountains at Alberta, Calgary. Initial cost \$100,000.